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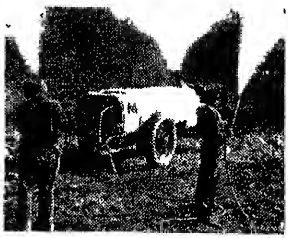

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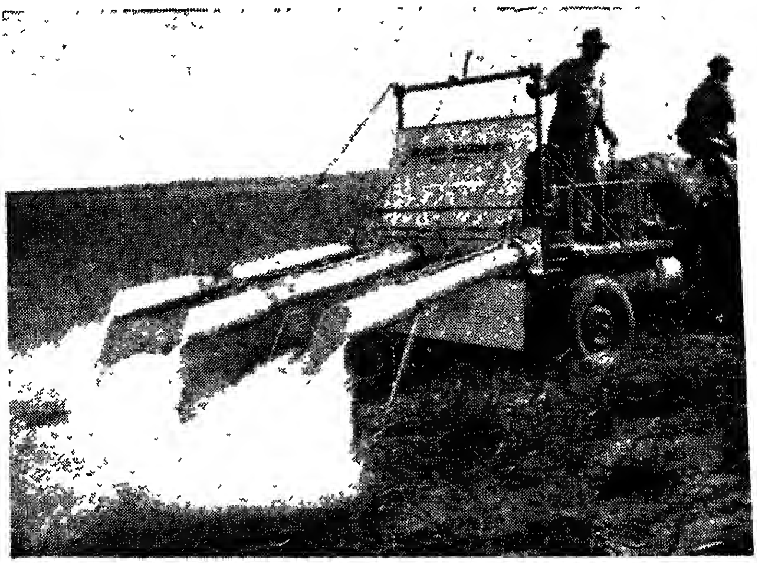

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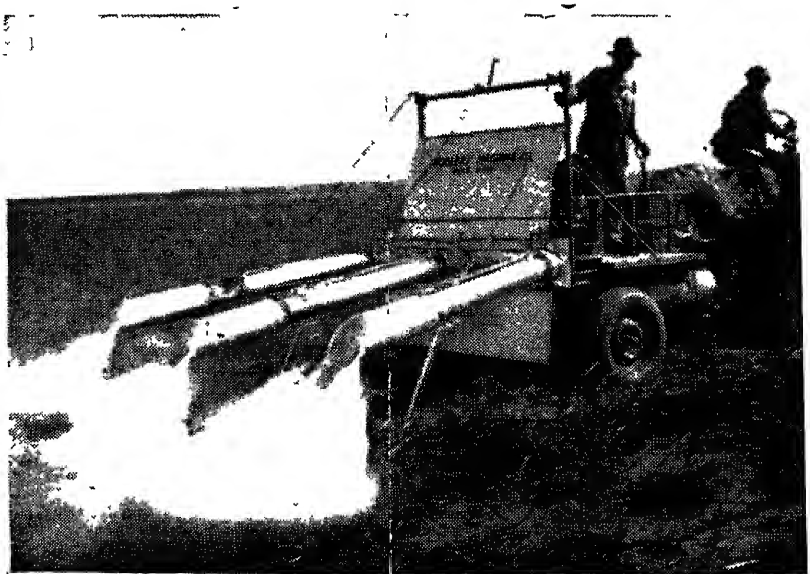

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NEW BRUNSWICK, N. J

DISCOLORATION OF POTATOES AFTER COOKING AS RELATED TO THEIR COMPOSITION*

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Agricultural Chemistry and Farm Crops, Michigan Agricultural Experiment Station, East Lansing, Mich

Some potatoes develop a grey, blue, or black discoloration during cooking, or upon standing after cooking. This condition has been reported from various regions in the United States and in many countries throughout the world and is particularly serious some years It impairs the attractive appearance of cooked potatoes but probably does not affect their nutritional value.

The discoloration occurs usually toward the stem end of the tuber but frequently is more generally diffused. The high temperature involved in cooking suggests that it is non-enzymatic in character. Tinkler (8) concluded that the discoloration may be caused by oxidation of a phenol or amine. Workers in the Bureau of Home Economics (2) attributed the change to compounds of the catechol type of tannins

Compared with normal potatoes, those which discolor after cooking contain in the raw state higher amounts of free amino acids and a more instable protein content (9). Tottingham, Nagy, and Ross state that boiling releases tyrosine and tryptophane which are oxidized by heat-stable catalysts to melanin pigments. Robison (6) maintains, however, that the color cannot be due to melanin as the latter is quite stable at pH 3 0 whereas the color in potatoes disappears at this pH. She found that the discolored tubers drawn from the same sample con-

*Journal Article No. 840 (N. S) Michigan Agricultural Experiment Station.

tained more iron (as extracted by 20 per cent H_2SO_4) than normal ones. Furthermore non-blackening potatoes could be made to blacken by soaking in $FeSO_4$ (iron sulphate) solution, washing, and boiling. She hypothesized that the precursor of the black pigment exists in the raw potato in the form of ferrous iron, bound in a loose complex possibly with protein. This complex is hydrolyzed on boiling and the iron precipitated as a colorless ferrous compound which is gradually oxidized to the black oxide as air penetrates the tissues This theory supports the observation that discoloration of normal potatoes is induced by contact with iron during boiling.

Conditions during the growth of potatoes are said to affect darkening. Parker (5) stated that soil conditions were more important than the variety of potato. Findlay (3) Merkenschlager (4) and Tottingham, Nagy, and Ross, (9) concluded that blackening was greater when the potash content of the soil was low. Nitrogenous fertilizers tended to aggravate this abnormality of the potato (10). On the other hand Smith, Nash, and Dittman (7) showed that varying levels or combinations of various levels of nitrogen, phosphorus, potassium, lime and manure had no consistent or predictable effect upon the occurrence of blackening, except as they may have altered the stage of maturity with reference to weather conditions, particularly temperature. Likewise they found that soil reaction, soil moisture, soil type, and deficiencies of boron, copper, zinc, manganese, and magnesium had no noticeably consistent effect. According to Tottingham, Nagy, and Ross (9) neither maturity, storage, temperature nor ventilation was a primary factor in the discoloration.

Susceptible potatoes may be prevented from discoloring by soaking the raw pared tubers for 2.5 hours in water or by boiling in acidified water.

Because of the inconsistency of the literature with respect to the factors affecting tuber blackening after boiling and because consumers discriminate against such potatoes, the following experiments were conducted.

Experimental

Samples of Russet Rural, Green Mountain, Sebago, and Chippewa varieties of potatoes consisting of five potatoes each were obtained from 100-pound lots entered by Michigan growers in potatoes shows at Marquette, Petosky, and Edmore, Michigan In January the potatoes were washed, dried, weighed and quartered. One stem-end quarter was plugged, the plug immersed in alcohol (11) and the discoloration rated The remainder of the quarter was steamed by autoclaving for 5 minutes

at 15 pounds pressure and observed after 0.5 hours for discoloration. The rating scale used ranged from 8 with no discoloration to 3 with intense blackening. Since the degrees of discoloration by the two methods were practically identical, only the data on steaming is given. The other stem-end quarter was weighed in a tarred crucible, dried in an oven at 100°C. overnight for determination of moisture and ashed in a muffle overnight at 550°C. After weighing, the ash was dissolved in dilute HCl and made up to volume. Aliquots were used to determine iron by the *o*-phenanthroline method (1) and manganese by the periodate method (12).

In the case of Green Mountain and Russet Rural, there were sufficient potatoes grown in restricted areas to permit segregation as to location In these instances potatoes grown within a 20-mile radius were treated as a group as well as combined in the total for all areas.

Results

Table 1 gives the results of the chemical analyses The average discoloration for the Sebago variety was similar to that for the Chippewa, and the discoloration for the Green Mountain variety was about the same as for the Russet Rural. The latter two varieties, however, discolored much more than the former.

Correlation coefficients between discoloration and the other constituents were determined statististically with the individual items. It was found that the correlation coefficients between discoloration and the moisture content within the particular lot was statistically significant to highly significant but between varieties, this correlation did not seem to hold For example, the Chippewa discolored the least yet contained the highest moisture content There was a significant relation between the darkening and the ash content for the Green Mountain variety, manganese for Chippewa, iron for Sebago and Chippewa, pH for Green Mountain and Russet Rural, weight for Chippewa. Again these relationships existed only within the lots.

Simple correlation coefficients were also computed between the following· pH and moisture, ash, manganese, iron; moisture and manganese, iron, ash and manganese, iron Multiple correlation coefficients were likewise obtained between discoloration, moisture and pH, moisture, manganese and iron; ash, manganese, and iron. Correlation coefficients for moisture and pH, and discoloration, moisture, and pH were highly significant for all varieties except the Sebago None of the others was significant.

TABLE I. *The average composition of different varieties of Michigan potatoes and their discoloration after cooking.*

Variety	Location Grown	Number of Potatoes	Dis-color-ation	Moisture	Ash	Manganese	Iron	pH	Weight
				Per cent	Per cent	Mg Per cent	Mg Per cent		Grams
Sebago	Upper Peninsula	29	7.5	77.2**	1.06	0.83	3.46***	6.27*	179
Chippewa	Upper Peninsula	32	7.4	80.6***	0.85	1.79**	3.52***	6.05	169**
Green Mountain	Republic, Mich	33	6.6	78.3*	0.77***	1.07	3.45	6.11	186
Green Mountain	Upper Peninsula	80	6.6	78.2***	0.79***	1.04	3.42	6.06***	175
Russet Rural	Rock, Mich	70	6.5	76.2**	0.93	0.81	3.83	6.07	154
Russet Rural	Manistique, Mich	23	6.7	76.4***	0.86	0.75	3.59	6.10***	159
Russet Rural	Edmore, Mich	32	6.5	77.0*	0.95	0.70	3.60*	6.05	179
Russet Rural	Upper and Lower Peninsula	144	6.5	76.2***	0.92	0.76	3.72	6.08**	161

***, **, * Correlation coefficient between discoloration and item starred significant at the one per cent level, at the five per cent level, and almost significant at the five per cent level, respectively.

Discussion

Although moisture is highly significant with respect to the degree of blackening of the four varieties of potatoes when drawn from the same lot, the correlation is not evident when comparison is made between tubers from different varieties This indicates that, whereas the moisture content is dominant, other factors are involved, but their role is minor or obscure

The pH is next in importance to moisture in producing discoloration which increases as the pH decreases. This may be due to hydrolysis of some constituent, such as sugar, which can then combine with the proteins to produce darkening. It should be borne in mind that this is separate and distinct from the reaction obtained by soaking or boiling the tubers in acidified water, which may extract the offending materials from the potato tissues

The evidence points to an effect of moisture and pH upon some unknown constituent or constituents on which the degree of darkening is more directly dependent.

Summary

Moisture, ash, manganese, iron and pH were determined on Sebago, Chippewa, Green Mountain, and Russet Rural varieties of Michigan-grown potatoes and correlated with the degree of discoloration obtained after steaming

The correlations between discoloration and moisture, between moisture and pH and between discoloration, moisture and pH were all highly significant within lots That between discoloration and pH was significant within some lots. The discoloration increased with increased moisture and decreased pH.

The study indicates that moisture is a dominant factor in discoloration of cooked potatoes but its influence is upon some more directly involved component

Acknowledgment

The authors acknowledge the advice of Dr. W. D Baten on the statistical treatment of the data

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ASSOCIATION OF SPECIFIC GRAVITY WITH DRY-MATTER CONTENT AND WEIGHT OF IRISH POTATO TUBERS[1]

E L LeClerg[2]

United States Department of Agriculture, Baton Rouge, La

Recently the specific gravity of tubers of Irish potatoes has received considerable attention as an index of dry-matter content and cooking quality In experimental work it is generally recognized that high specific gravity of tuber is positively associated with high cooking quality and high dry-matter content The literature dealing with this subject has recently been reviewed by Dunn and Nylund (3) [3]

The present study was made to determine the relationship of variety and location to the association between specific gravity and dry-matter content, specific gravity and weight, and dry-matter content and weight

This study included 50-tuber samples of the Houma and of the Green Mountain varieties; one sample of each was harvested at Baton Rouge, Louisiana in June 1945, and one of each at Crossville, Tennessee in August 1945.

The specific gravity of each tuber was determined by immersion in salt solutions of different concentrations, as used by Clark, Lombard, and Whiteman (2), and others Subsequently each tuber was washed, numbered, weighed, and sampled for dry-matter content For

[1]Cooperative investigations by the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, and the Louisiana Agricultural Experiment Station

[2]Pathologist, United States Department of Agriculture, stationed at Baton Rouge, Louisiana

[3]Figures in parentheses refer to "Literature Cited"

TABLE I.—*Frequency distribution, based on specific gravity determinations of tubers of Green Mountain and Houma varieties of Irish potatoes grouped according to the respective dry-matter content Tubers grown at Baton Rouge, Louisiana and, Crossville, Tennessee, in 1945*

Range of Dry Matter Content Per cent	Specific Gravity[1]				Weighted Average Specific Gravity
	Louisiana		Tennessee		
	Green Mountain	Houma	Green Mountain	Houma	
17 01 — 18 00		1 055 (7)		1 054 (2)	1 054 (9)
18 01 — 19 00		1 056 (12)		1 059 (6)	1 057 (18)
19 01 — 20 00	1 064 (3)	1 061 (18)	1 060 (2)	1 063 (24)	1 063 (47)
20 01 — 21 00	1 066 (14)	1 064 (11)	1 067 (5)	1 065 (12)	1 065 (42)
21 01 — 22 00	1 069 (12)	1 064 (2)	1.070 (4)	1 068 (5)	1 068 (23)
22 01 — 23 00	1 074 (15)		1 075 (14)		1 074 (29)
23 01 — 24 00	1 078 (6)		1 080 (13)	1 067 (1)	1 079 (20)
24 01 — 25 00			1 081 (10)		1 081 (10)
25 01 — 26 00			1 083 (2)		1 083 (2)

[1]The numbers in parentheses refer to the number of tubers in each class

the determination of dry-matter content, each tuber was grated over a kitchen vegetable grater, the resultant mass of fine pulp being thoroughly mixed, and two 10-gram samples of this pulp were weighed into small metal cans equipped with tightly fitting lids Into each can enough 95-per cent alcohol was added to cover the mass of pulp. The samples were then dried in an oven at 95° F, for 48 hours after which the dry weight was determined.

Experimental Results

The data in table 1 show the relation between specific gravity and dry-matter content of Green Mountain and Houma at both Baton Rouge, Louisiana, Crossville, Tennessee These results agree with those presented by other workers in that the specific gravity increased as the dry-matter content of the tubers increased

A rather definite differential location effect, as regards the relation between specific gravity and dry-matter, existed with Green Mountain, and to a lesser degree, with Houma. This is apparent, for example, with Green Mountain because more tubers at Crossville, Tennessee, occurred in higher specific-gravity groups than at Baton Rouge, Louisiana This difference probably is because the greater rainfall at Baton Rouge resulted in higher moisture content of tuber with subsequently lower specific gravity values

The linear correlation coefficients between specific gravity and dry-matter content, as indicated in table 2, varied from +0 81 to +0 85 for the two varieties at the two locations These values compare closely with a correlation coefficient of +0 82 reported by Bewell (1) and of +0 87 recently reported by Dunn and Nylund (3).

Table 2—*Correlation coefficients for comparisons of specific gravity, dry-matter content, and weight of tubers of Green Mountain and Houma varieties of Irish potatoes grown in Louisiana and in Tennessee in 1945.*

Comparisons	Correlation Coefficients in—			
	Louisiana		Tennessee	
	Gr. Mt	Houma	Gr Mt	Houma
Specific gravity *vs* dry matter	+0 82**	+0 83**	+0 85**	+0 81**
Weight *vs* dry matter	—0 13	+0 03	—0 10	—0 08
Weight *vs* specific gravity	—0 22	+0 01	+0 07	—0 19

**Highly significant

No previous work of this kind has been done with more than one variety at a time The four correlation coefficients for the comparison of specific gravity and dry matter are not significantly different (table 2) Thus, it is apparent that soil and climatic conditions for plant

growth in this instance did not materially influence the relationship between specific gravity and dry-matter content of potato tubers Furthermore, insofar as the 2 varieties were concerned, the relationship was practically the same for each one

Neither specific gravity nor dry-matter content was significantly correlated with weight of tuber This was true with both varieties in the two locations This is borne out by the data in table 2 in which case all of these correlation coefficients were of a very low value and non-significant

Summary

Specific gravity and dry-matter content determinations were made on 50 tubers of both varieties of Irish potatoes grown at Baton Rouge, Louisiana, and at Crossville, Tennessee

The degree of relation between specific gravity and dry matter was indicated by a linear correlation coefficient of +0 81 to +0 85

Soil and climatic conditions for plant growth did not materially influence the relationship between specific gravity and dry matter. The relationship was practically the same for each of the 2 varieties tested

Neither specific gravity nor dry-matter content was significantly correlated with weight of tuber This was true for both varieties in the two locations

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THE USE OF ETHYLENE CHLOROHYDRIN FOR BREAKING THE REST PERIOD OF LARGE QUANTITIES OF POTATOES

W F Porter[1] and G W. Simpson[2]

Maine Agricultural Experiment Station, Orono, Maine

Introduction

Denny[3] of Boyce Thompson Institute developed a treatment with ethylene chlorohydrin to hasten the germination of dormant potato tubers, thus securing plants from recently harvested potatoes much sooner than would have been possible otherwise

[1]Program Director, Maine State Seed Potato Board

[2]Associate Entomologist, Maine Agricultural Experiment Station

[3]Denny, F E Hastening the sprouting of dormant potato tubers Amer Jour Bot 13 118-125. 1926

Following a severe epidemic of leafroll in 1937, seed potato growers in Maine realized the importance of securing advance information on the desirability of particular seed stocks for further propagation as has been secured for a number of years in other states,—notably New York.

Since Denny's work had been confined to small quantities of potatoes for use in experimental studies, his method was not readily adaptable where carload lots of potatoes were involved Such adaptation has been made in Maine The experience gained here in treating large quantities of potatoes may be of considerable value to officials in other states, where advance testing of seed stocks is gaining favor as time goes on The method described below has proven to be a successful one for securing advance information on the virus content of seed stocks by the 25th of January from samples of tubers harvested (in Maine) as late as early October of the previous year.

Methods and Procedure

Chambers Two types of gas chambers have been available for the work One type was built originally as a cold-storage locker A number of such lockers were constructed in an underground potato storage cellar and were thoroughly insulated with cork Each is approximately 11x12x10 feet in size. All of them have tightly fitting doors and false floors to facilitate air circulation

The other type of chamber was constructed by partitioning off a part of the building immediately above the lockers already described. The rooms are not so tight as the ones below, although all wall space is insulated with ground cork. The rooms have outside windows which are covered with panels of plywood during the gassing period. They are approximately 14x16x9 feet in size.

Arrangement of Potatoes in Gas Chamber Experience has indicated that the arrangement of the sacks in the gas chambers has a bearing on the results secured. All samples to be treated are first placed in sacks made from 10-ounce burlap. In so far as possible all samples of each variety of potatoes are grouped in a chamber by themselves,—for reasons to be stated later. The first row of sacks on the floor is placed leaning against the back wall at an angle of 30 to 40 degrees to allow for air circulation along the row back of the sacks, with an interval of one foot between each end of the row and the side wall Succeeding rows on the floor are placed as snugly as possible one against the other Meanwhile a second tier of sacks is placed on the first, the first row again at an angle against the back wall and the others fitted

snugly If a third tier is needed it is placed similarly. In piling the sacks as indicated, the shape of the sacks will provide sufficient space between tiers of sacks for proper circulation

Heating and Air Circulation Since preheating of the potato samples is necessary before gassing is started and because the potatoes must be kept warm during the 5-day gas treatment, heating equipment was installed in each of the chambers used Electric fin strip heaters are used with continuously operating electric fans to dissipate the heat from the strips and to help circulate the air in each room Automatic control of the temperature is obtained by means of thermostats It is believed that steam or hot water heat would be equally satisfactory for this purpose.

It has been found necessary to provide for additional air movement, especially when 200 to 550 95-pound sacks of potatoes are placed in a chamber, and the chamber is nearly filled To assure sufficient circulation, a fan capable of moving about 2,000 cu ft. of air per minute has been found most satisfactory. These larger fans are used to circulate the air throughout the preheating and gassing period

Gassing. The ethylene chlorohydrin is introduced when the potato samples in the gas chamber have been brought to a uniform temperature of 75° to 80° F. During the early part of the 5-day treatment, the anhydrous chemical is diluted by adding 6 parts of water to 4 of the chemical by weight It has been found in using the diluted gas that the humidity in some of the gas chambers rises to the saturation point on the second or third day of the treatment. If this condition occurs it is far easier to evaporate the anhydrous chemical than to continue the use of the diluted material.

An attempt is made to have the ethylene chlorohydrin evaporating throughout the 5-day treatment Evaporation is aided by placing toweling in front of the fin strip heaters, behind which are the fans used to dissipate the heat The toweling is hung from the ceiling of the chamber and dips into a pan container into which ethylene chlorohydrin is poured from time to time Glass containers are most practical for this purpose

The amount of gas needed is determined by the weight of the potatoes in each chamber. The potatoes are weighed just before being placed in the chamber.

The present practice is to assure the evaporation of one quart of 40 per cent ethylene chlorohydrin to every 600 to 720 pounds of potatoes. The gas treatment is continued until this amount has evaporated or until 5 days have elapsed. In most instances these 2 events

coincide reasonably well Considerable attention must be given to each gas chamber during the treating period If the temperature of the bin is found to be rising above 82° F due to physiological activity within the tubers, or when the humidity rises to the saturation point, it is desirable to provide outside ventilatioin. This may be done by opening the door of the gas chamber a few inches for a period of 5 or 6 hours,—depending on conditions.

Although blackheart has never been evident in potatoes treated by this method, failure to provide adequate outside ventilation at intervals may bring about such a condition The temperature of the gas chambers should not be allowed to rise above 82° F

The gas chambers are ventilated for a period of 12 hours after the 5-day treatment The gassed potatoes are then kept at a temperature of 75° to 78° F. until loaded for shipment to Florida This is usually for a period of 2 or 3 days.

The potato samples are shipped to Florida in refrigerator cars Before loading the samples from the gas chambers, the cars are heated to a temperature of 80° F.

Varietal Reaction. Growth of plants in Florida has indicated, on numerous occasions, that there is a great deal of difference in the reaction of certain varieties to the ethylene chlorohydrin treatment Most of the commercial varieties grown in Maine are successfully handled by a single 5-day treatment However, Cobbler and Russet, among the older varieties, and Mohawk, among the newer varieties, have proved to be more difficult to gas effectively This difficulty has been overcome by giving tubers of these varieties a second 5-day treatment after an interval of 12 to 15 hours The chamber is thoroughly ventilated during the 12- to. 15-hour interval between treatments This amounts to doubling the quantity of ethylene chlorohydrin used but the uniform stand obtained in Florida amply justifies the extra effort and cost

Results

The basis on which the success of the gas treatment must be judged is the uniformity of the stand of plants in Florida and the rapidity with which they reach a size large enough to provide a sound basis for determining the amount of any virus disease that may be present The tubers are planted whole

Stand counts indicate that there is some difference between varieties but that better than 95 per cent of the gassed potatoes emerge and produce plants large enough to read for virus diseases by the end of

January In 1945 the emergence of Irish Cobblers was 95 per cent, Chippewa, 96; Green Mountain, 95; Katahdin, 96; Sebago, 95, and Russet Rural 95 per cent

Field counts to determine the percentage of virus have been made in a number of instances during several seasons These counts indicate that the 5 per cent of the tubers that fail to produce plants in Florida do not differ materially in the percentage of infected tubers from the tubers that do produce plants. Hence the failure of some tubers to produce plants does not materially alter the reliability of the test from a grower's point of view.

The results based on the handling of approximately 3,000 bushels of potatoes annually have been satisfactory only when each variety is handled in the manner found best suited for breaking dormancy of that particular variety.

TABLE I—*The use of ethylene chlorohydrin for the breaking of dormancy in certain potato varieties.*

Variety	Kind of Chamber[1]	Amount of 40 per cent Solution of Ethylene Chlorohydrin	Duration of Treatment. Days[2]
Chippewa Sebago	Either	1 qt to 720 lbs. potatoes	5
Bliss Triumph Earlaine #2 Early Rose Green Mountain Houma Katahdin Pontiac Sequoia Teton B70-5	Either	1 qt to 660 lbs potatoes	5
Irish Cobbler Mohawk Russet Rural Warba	Tight	2 qts to 660 lbs potatoes	10[3]

[1]If chamber is not filled, experience has indicated a need for ⅓ more gas than the weight of the potatoes requires when a chamber is full

[2]Temperature in all cases held between 75° and 80° F

[3]Divided into 2 5-day treatments with an interval between for thorough ventilation of the chamber.

The data presented in table 1 were based on the results obtained from the treatment of approximately 5 freight carloads of potatoes in 1945.

Summary

Results of treating about 3,000 bushels of potatoes a year with ethylene chlorohydrin to break the rest period have indicated that varietal differences exist, necessitating variations in the treatment of tubers to secure uniform results from the growth in Florida When each potato variety is treated in a certain way with respect to temperature, ventilation, and liberation of ethylene chlorohydrin, 95 per cent of the tubers produce plants large enough to furnish a virus percentage reading by the end of January.

SECTIONAL NOTES

ALABAMA

The commercial potato growers in the counties of Baldwin and Escambia have been slow in indicating just how many acres they will plant this spring. This was probably due to the "wait and see what happens attitude" in regard to the Government support program The allotted plantings for the two counties total near 17,000 acres with small plantings of under three acres in additional up to 4,000 acres. Most of the growers plant more than three acres and therefore will come under the allotment plan if they are to benefit from the support program It is generally considered that Baldwin County will probably plant 14,000 acres and Escambia County will plant probably 3,500 acres. This total of nearly 18,000 acres is about 20 per cent less than last year's plantings.

It is estimated that 60 per cent of the potatoes will be Bliss Triumph and the balance Sebago Seed is arriving in increasing amounts daily because of shipments before the 1st of January to avoid increase in railroad freight cost. Most of our seed will be in the county by the 10th of January This will be a temptation for our growers to plant early, should springlike weather continue.

Most of our growers are worried about Late Blight and are preparing to either dust with copper-DDT or to spray with Dithane. Late blight is still being found on volunteer tomato plants in semi-protected field conditions Although this may not be the same strain of the Late Blight, most of us feel that we will have Late Blight on potatoes as soon as conditions for its development appear. (Jan 3).—FRANK E. GARRETT.

CALIFORNIA

All our potato growers have received their allotments from the County Committee—some are happy, some are satisfied, and some dissatisfied with the goals given them Just what will take place with reference to actual acreage plantings is impossible to state at this time, but it appears that there will be a reduction under the large acreage produced in this county last year. (Dec. 23) —M A LINDSAY

IDAHO

The condition of the Idaho crop that is in storage is rather poor in some sections. Many growers and dealers report that potatoes are deteriorating rapidly in some sections. Possibly this is due partly to field frost in some cases and in other cases to immaturity of the tubers as a result of vines being green and growing until harvest.

The harvest season was very difficult, with labor shortage, frosts and wet weather, which resulted in many potatoes being placed in storage in poor condition. All indications are that the shrinkage in storage will be considerably more than normal

Meetings have been held with growers in all of the seed potato-growing areas of the state. Seed growers in all of these areas have expressed concern about the fact that the Government support program is not really of benefit to seed growers, since it is based on No. 1 and No. 2 grades and much of the seed produced is too small for these grades. This may have some effect on the seed potato acreage for 1947. (Dec. 30) —JOHN R. ROBERTSON.

INDIANA

Our potato crop has been disposed of and at a satisfactory price to the growers. We had an exceptionally fine crop,—good yields and good quality. Numerous growers on the muck soils averaged 500 bushels or more per acre of No 1 quality. With good quality the growers found it easy to put up a good pack which they hope to maintain in the future. It appears that 3 per cent DDT put in the regular spray or dust program gave an estimated increase of 20 per cent more potatoes per acre.

The Katahdin, Irish Cobbler and Chippewa continue to lead all varieties. Our growers have not become favorably impressed with some of the newer introductions. The intentions for 1947 plantings will be about the same as the average for the past five years. (Dec. 27). —W. B. WARD.

MAINE

Aroostook potato growers made approximately 2300 special loans and 3650 regular loans under the price support program Only about one-half million bushels were stored in piles in the field and covered with straw, boughs and dirt All of these have deteriorated beyond use About ten million bushels were stored in temporary storage,—some of these were moved into regular channels of trade, to starch factories and alcohol plants, but about seven million bushels deteriorated beyond any useful need and were dyed and disposed of.

The support program is the only thing which keeps potatoes nearly at the support level Most farmers have already offered 20 per cent under their December quota and are starting to offer 20 per cent in January. The hope of the industries is that these can be disposed of soon.

Meetings to explain the 1947 allottment program were very well attended and farmers are willing to accept the state allotment of 182,500 acres. The county committee will be establishing goals during January.

The seed market is dull with orders coming in slowly. Apparently buyers are waiting for allotments, waiting for the Florida Test or are just not going to buy. One surprising thing is the lack of orders for Chippewas. It would appear that this variety is losing favor in some states.

The Aroostook County Farm Bureau is calling a meeting of state and federal workers to discuss the ring rot situation,—which is serious, —with some table stock growers (Dec. 31) —VERNE C BEVERLY

NEBRASKA

The Nebraska growers of certified potatoes harvested one of the largest crops on record The total tonnage is second to the 1945 crop The yield per acre exceeded the 1945 crop, and established a new high for certified potatoes. In a breakdown of the crop by varieties, the Bliss Triumph exceeded the record crop of 1945, and is the all-time record total production of that variety.

In view of record tonnages produced by the other states throughout the nation, the Nebraska growers are faced with difficulties in marketing their crop. They report that the first grade, that is, Blue Tag Certified, sells readily, but second grade packs are going begging, the same being the case with table stock potatoes shipped out of the state Unfortunately, the grade-outs were higher than usual, owing to very unsatisfactory conditions at time of harvest. Nebraska growers

were faced with rain, snow, cold weather, and a combination of the three during most of the month of October, so conditions were extremely poor This resulted in a high percentage of mechanical injury that reduced the quality.

A strange situation exists in that potatoes graded out of a lot, when failing to make U S No 1, instead of being U S No 2, are usually unclassified, that is, they are so severely damaged they cannot go as No 2 or Commercial Grade. This lowest pack, both table and seed, is going begging on the market, and much of it will probably wind up in stock feed before the crop is disposed of

The growers of the late crop potatoes, seed and table, are having usual difficulties with shortage of cars That has existed for the past three seasons Receivers of certified seed potatoes in the south have ordered shipments to be made much earlier than usual. In this they hope to beat the car shortage that develops right after the first of the year, and obtain their seed needs. One of the largest distributors of certified potatoes in Nebraska reported in mid-January of 1946 that they were over 200 cars behind on shipments This year they determined to avoid this by starting out shipments for Louisiana and Alabama that were normally moved in mid-January, as early as mid-December. The usual slack season around the Christmas holidays has seen the heaviest movement of seed potatoes in many years Prices for the 1946 crop are about comparable to 1945 for the better grades Lower grades are below the levels set a year ago Most of the prices are at Government support or above The Government loan program is in effect, but covers only a small portion of the crop, part of which is being moved at this time.

Planting indications for next year are still rather indefinite, however, their is expectation of a slight decrease The allotment program asks for a slight decrease, and this will probably be met. (Dec. 26) — MARX KOEHNKE

NEW YORK

December has been a dull month as far as potatoes are concerned We have had considerable winter weather since the first of the month which has curtailed a lot of truck deliveries We understand that a car shortage exists in some of the sections that ship potatoes into our territory but we can see no evidence of a shortage of potatoes anywhere in our up-state markets Prices have remained the same as during November, varying greatly in different areas but generally around \$2 00 cwt. Some truckers have, however, picked up good table stock at \$1 50 out of uninformed areas.

We understand there was quite a rush for coverage under the support program during the last week of its availability and we hope enough potatoes are covered to bring the market level somewhere near the support prices after the first of the year.

Seed growers are quite concerned because of the slow movement and also inquiries regarding certified seed. Apparently buyers of seed have their cellars full and are in no hurry to get covered on spring requirements. Some have expressed their thought that potatoes would be cheaper in March but it is the opinion of our growers that with the big shrinkage being noted in varous areas and the high percentage under the support program that good seed will tend to be scarce rather than plentiful Many of our growers have oversize seed which will go to the table stock market but the grower who has high quality medium size seed is holding for a considerable premium over the support price (Dec. 19).—H J. Evans

NEW YORK

This is the time of year when potato growers are considering plans for another year but have not yet made definite decisions. Government acreage control and price support programs will have some influence on the 1947 acreage With a 1946 crop of 42,570,000 bushels which is 52 per cent above the 5-year average and 47 per cent above 1945, growers do not anticipate much improvement in the spring market

It has been estimated that between 2 and 3 million bushels of the big Long Island crop are still in piles in the field. Most of these are under government loan and may or may not be fit for any commercial use. The exterior of most of these piles has been frozen and it is not known whether the interiors are sound.

Results of the 8 farm bureau potato variety trials have been summarized and are being publicized. Among the newer varieties which performed well enough to put them into commercial production in upstate New York are Virgil, Placid, Erie, Ontario, Mohawk and Teton. As a group these are likely to supercede largely the old Rural Russet Rural, probably because of its popularity for chip-making is holding on better than the smooth-skinned Rural Katahdin and Green Mountain are maintaining their popularity well, especially Katahdin upstate and Green Mountain on Long Island Even though Katahdin seldom yields as well as most other main crop varieties, it is a fairly "sure-cropper," stores and sells well.

The 12th joint annual meeting of the Empire State Potato Club and the New York State Vegetable Growers' Association was held

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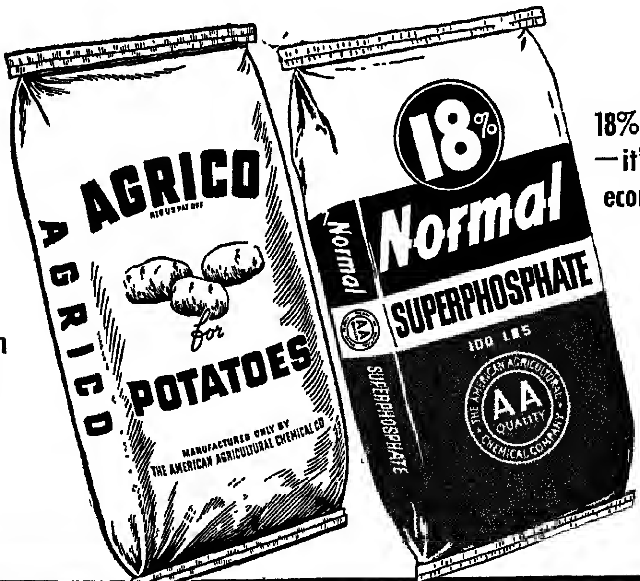

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THE NATION'S LEADING FERTILIZER — SUPERPHOSPHATE

at Rochester on the 9th and 10th of January Here our growers held their annual potato show, discussed the progress of our potato research program, and also federal control of acreage and prices in 1947 (Jan)—E. V HARDENBURG.

OREGON

The Oregon potato production for 1946 is estimated at 13,000,000 bushels compared with 12,324,000 bushels in 1945, and a 1935-1944 average of 7,574,000 bushels. It is estimated that approximately 2,-500,000 bushels of potatoes were put under loan by Oregon producers this fall. The farm prices for potatoes during October and November were $1.30 per bushel, during July, August and September they were $1.35 per bushel.

A considerable portion of Oregon potato production is seed potatoes and growers have been concerned with the effect the 1947 support program would have on 1947 planting of potatoes and demand for seed

The planting of samples from all certified and foundation lots of potato seed was made during the week of December 1 in the test plots at Oceanside, California

Information revealed at the Oregon Seed League annual meeting showed that the quality of russet seed potatoes has been seriously affected by leafroll. Two-thirds of all russet acreage entered for certification in 1946 was rejected because of leafroll There are very few foundation seed growers of russets and more are needed White Rose seed showed a decrease of disease in 1946 There are a good number of foundation White Rose growers

The leafroll causing so much difficulty is thought to be a more virulent strain of leafroll or a different but very similarly appearing disease (Dec. 16) —W. G NIBLER.

WASHINGTON

Mr. Charles D. Gaines, who has resigned his position as Supervisor of the Seed Division for the Washington State Department of Agriculture has been with the Washington Co-Operative Farmers' Association at Mt Vernon, Washington, since last February Potato certification is now being carried on under the supervision of Harold S Schaad who has been with the Division for the past three seasons He is assisted by two well qualified potato specialists, Paul A. Fraser and Henry C. Williamson, both veterans of World War II. All three men are graduates of Oregon State College with seed growing experience.

With the fine results obtained from greenhouse testing seed po-

tatoes this fall buyers are becoming very much interested in Washington seed. The reason for the fine seed grown is attributed to the excellent plot-tested disease-free foundation seed stock used last spring It is estimated that seed harvested this fall has 95 per cent less leafroll and mosaic than the crop harvested in 1945 All seed stock harvested is grown in bacterial ring rot-free areas Ring rot has not been a factor in growing Washington certified seed potatoes. The growers can well be complimented for this wonderful accomplishment during 1946

For the past season plans have been underway to greenhouse test immediately after harvesting the crop The growers feel that buyers are entitled to know the approximate percentage of tuber-borne virus that the seed carries This next season (1947) the Washington Department of Agriculture plans to have under greenhouse test every lot of seed potatoes produced. These tests will be under the supervision of the inspectors These results will provide an index of the approximate amount of virus in each lot grown The results should be available for the White Rose and other early varieties by the first part of November and December for the Netted Gem or late planted varieties

This past season the inspectors made a special effort to personally field sample for outdoor plot and greenhouse testing, each lot of seed potatoes grown This field sampling was done approximately 10-14 days after the vines were killed by the use of calcium cyanamid, frost or various chemicals. From information gathered from the test plots in 1945 it was found that in order to obtain a fair and complete test of the amount of tuber-borne virus the vines must be completely killed at sampling time. It was found that field sampling after the vines were completely dead gave better and more accurate results than any other method used It is our experience that it is impossible to secure a representative sample from potatoes stored in a bin or sacks This season the inspectors traversed the fields in the form of an X taking one tuber from each hill Two hundred and ten tubers were taken from two to four ounces in size from each field of 20 acres or fraction thereof, in the case of larger fields an additional sample was taken for each additional 20 acres.

We have also found that for early outdoor test plot work it is best to use single drop seed from 1 to 2 ounces rather than tubers larger cut in two's and planted in units It seems that the cut tubers break down more readily after gassing with anhydrous ethylene chlorohydrin This is especially true when the soil is cold for a week or more after planting

The samples from fields that were eligible for foundation from

past season's performance and field inspection tolerances were tested in the greenhouse Duplicate lots were planted in the Oceanside, California, plots. Foundation rating will be given only to those lots that pass the field inspection standards and test plot tolerances set up in the certification regulations. By this method of tagging growers will be able to sell seed as foundation which will perform for the buyer as represented by the seal and certification tag attached This method of certification will assure the buyer of good quality, dependable seed

This season the Washington seed potato growers have 162 samples planted in four acres of plots at Oceanside, California. These plots were planted on the 8th of November and it is planned to have the disease readings by the 1st of February The plots represent samples from 63 growers of the following varieties White Rose, Netted Gem, Sebago, Bliss Triumph, Irish Cobblers, Gold Coin, Beauty of Hebron, Katahdin, Burbank and Earliest of All There were 1,539 acres that passed the field inspection of which 60 per cent were White Rose, 36 per cent Netted Gems and 4 per cent other varieties (Dec 31) — HAROLD S. SCHAAD

Most of our growers are a bit undecided about next year's production Our seed growers are holding most of their crop,—subject to the Southern California test plots. These readings will not be available, probably, until February.

Our disease control problem has been definitely on the increase and the buying market is much more critical of the condition of seed potatoes purchased With the general potato situation being less bright, it seems likely that both seed potato acreage and commercial potato acreage will be reduced in Washington in 1947 (Dec 24) —CHAS D GAINES

REPORT OF THE THIRTIETH ANNUAL MEETING OF THE POTATO ASSOCIATION OF AMERICA

The thirtieth annual meeting of the Potato Association of America was held in the Roosevelt Room, Hotel Morrison, Chicago, from December 2 to December 4, 1946 President E B Tussing of Ohio presided E L Newdick of Maine was asked to serve as Secretary for the meetings The meetings were well attended, with nearly 100 present, and the reports presented were of great interest These reports

will be printed in the American Potato Journal from time to time during the year

The following officers and members of the Executive Committee were elected to serve for 1947

Marx Koehnke, *President*—Nebraska Certified Potato Growers, Alliance, Nebraska

W N Keenan, *Vice-President*—Department of Agricultue, Ottawa, Canada.

Wm H Martin, *Secretary-Treasurer, Editor*—Agricultural Experiment Station, New Brunswick, New Jersey

H A Reiley—Michigan Potato Growers' Exchange, Cadillac, Michigan

Frank Garrett—Department of Agriculture, Fairhope, Alabama

O D Burke—Pennsylvania State College, State College, Pennsylvania.

Reiner Bonde—University of Maine, Orono, Maine.

George List—Colorado Agricultural and Mechanical College, Fort Collins, Colorado

The following committee was appointed to serve throughout the meetings

Nominating Committee—A. G Tolaas, H J Evans, H. O Werner.

Report of the Committee on Resolutions

We, the members of the Potato Association of America, at our thirtieth annual meeting, wish to commend Drs W H Martin and Elizabeth S Clark for the excellent manner in which they have conducted the affairs of the association and the American Potato Journal during the recent difficult years, and we hereby wish to express our appreciation for this loyal service

Resolved, that the Executive Committee communicate with others interested in the potato industry with a view of developing an overall coordinating agency

Resolved, that we express our thanks to Bruce Jones for his services and untiring efforts in helping to arrange for this meeting

After some discussion of a meeting place for next year, it was agreed that this should be decided by the Executive Committee It was also agreed that the newly elected Executive Committee should take the necessary steps to revise the constitution and by-laws of the Potato Association

The report of the Secretary-Treasurer was read and approved

Report of the Secretary-Treasurer

When your secretary-treasurer took the oath of office in 1933, the membership in the Potato Association of America numbered 322 There has been steady but slow growth over the years, with a membership of 2,152 in 1946 It is of interest to note that Canada has 55 members, England 30, Russia 33, South America 30 and other foreign countries 43 There is reason to believe that the number of foreign subscriptions will increase in the next several years

Here at home, the states with the largest memberships are North Dakota, New Jersey, New York, Washington and Minnesota This, of course, results from the fact that these states have taken out group subscriptions It is unfortunate that some of the other important potato-growing states, including Maine, Pennsylvania, Idaho, and Michigan have so few members in relation to the size and importance of the industry

The financial condition of the association is excellent. As will be seen from the treasurer's report, we have a balance of $1,986 32 on hand as of November 20, 1946

When your treasurer took over, the association had a balance of $264 78. Unfortunately, before the transfer of these funds was made, the Michigan bank in which they were deposited closed its doors We are happy to report, however, that the final payment on this account was made in 1944 At the close of our first year of operation, we showed a balance of $31 12 Times were bad and by 1941 the balance amounted to only $10 98 At the same time, we were advised by the printer that we owed him approximately $900 00 By cutting costs, by making a drive for additional advertising through employing Macfarland & Company of New York, and by increasing the number of subscribers, we managed to pay all outstanding bills and now have a cash balance of nearly $2,000 The financial situation of the association has never been so good

Your editor has carried the responsibility for the Journal since 1932 It has required considerable time and some headaches Without the fine assistance rendered by Dr Elizabeth S Clark, who handles the details of proof reading, checking manuscripts, etc , the job would be impossible.

STATEMENT FOR 1945 AND THE YEAR ENDING NOVEMBER 20, 1946

Receipts	1945	1946
Balance from previous year	$ 417 99	$ 924 63
Annual dues	1,654 34	2,234 42
Sale of advertising	1,821.57	2,386 25
Sale of reprints	361 30	272 10
Miscellaneous	261 25	191 42
Total Receipts	$4,516 45	$6,008 82

Disbursements	1945	1946
Printing and Mailing of Journal	$2,575 00[1]	$2,871 67[2]
Reprints	211 93	311 00
Postage and Supplies	250.40	316.15
Miscellaneous	14 49	23 68
Secretarial Work	300 00	300 00
Stenographic Service	240 00	200 00
Total Disbursements	$3,591 82	$4,022 50
Bank Balance	924 63	1,986 32

[1] 13 issues, Dec, 1944-Dec, 1945, incl
[2] 9 issues, Jan, 1946-Sept, 1946, incl.

Accounts Receivable
Advertising—September and October

Accounts Payable
Issue—October, 1946

Report of the Auditing Committee

We, the undersigned Auditing Committee, have examined the books of the Potato Association of America and have found them to be correct

(Signed) JOHN C CAMPBELL,
RUSSELL E LONG,
MILTON A SPRAGUE

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of American Potato Journal, published monthly at New Brunswick, New Jersey, for Jan 1, 1947.

State of New Jersey
County of Middlesex ss

Before me, a Notary Public in and for the state and county aforesaid, personally appeared W. H. Martin, who having been duly sworn according to the law, deposes and says that he is the Editor of the American Potato Journal and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc, of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411. Postal Laws and Regulations, printed on the reverse of this form, to-wit

1. That the names and addresses of the publisher, editor, managing editor, and business managers, are:

Publisher—Potato Association of America, New Brunswick, New Jersey.
Editor—W H Martin, New Brunswick, New Jersey.
Business Manager—W H. Martin, New Brunswick, New Jersey

2. That the owner is (if owned by a corporation its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given).

Potato Association of America, New Brunswick, New Jersey

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are (If there are none, so state) None

4. That the two paragraphs next above, giving the names of the owners stockholders and security holders, if any contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholders or security holders appear upon the books of the company as a trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given, also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities, in a capacity other than that of a *bona fide* owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him

5 That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is—(This information is required from daily publications only).

W. H MARTIN, Editor.

Sworn to and subscribed before me this 1st day of January, 1947.
R E Long, Notary Public, Middlesex County, New Jersey.
(My Commission Expires January 31, 1949).
Form 3526—Ed 1924

American Potato Journal

PUBLISHED BY

THE POTATO ASSOCIATION OF AMERICA

NEW BRUNSWICK, N. J.

THE PERFORMANCE OF NEW FUNGICIDES FOR CONTROLLING LATE BLIGHT ON POTATOES[1]

R. S. DAVIDSON AND A. E. RICH[2]

Rhode Island Agricultural Experiment Station, Kingston, R. I.

Bordeaux mixture is generally considered the most effective spray for controlling potato foliage diseases, especially late blight, caused by the fungus, *Phytophthora infestans*. However criticisms of Bordeaux often cited are that it causes injury to plants, is difficult to mix and is corrosive to spraying equipment. Certain organic fungicides tested in the laboratory and greenhouse lacked some of the objectionable qualities as well as exhibiting desirable fungicidal properties. The performance of these materials was compared with Bordeaux in the field on Green Mountain potatoes during the summers of 1945 and 1946. Fortunately, from the standpoint of optimum conditions for conducting such tests, blight was unusually severe both seasons. Although none of the materials tested in either 1945 or 1946 proved so effective as Bordeaux on the basis of yield, it seems desirable at this time to report the comparative action of the various spray materials tested.

1945 FIELD TRIALS

In 1945, 13 different spray materials were applied in the field as sprays to single rows of potatoes 275 feet long. Each treatment was randomized within blocks replicated 4 times. The materials and the

1 Contribution No. 694 of the Rhode Island Agricultural Experiment Station, Kingston, R. I.

2 Assistant Plant Pathologist and Assistant Agronomist, respectively.

TABLE 1 —1945 *Field trials with new fungicides*

Treatment	Conc. per 100 Gal H_2O	Per cent of Foliage Blighted, Average of 4 Replicates						Average Yield Bu per Acre	Per cent U S No 1
		7/19	7/24	7/31	8/9	8/14	8/23		
Phenyl mercuritriethanol ammonium lactate (P N-5-E)	100 ppm.	2.0	5.0	44.0	77.0	85.0	100.0	123.0*	74
Phenyl mercury formamide (P 806)	100 ppm	1.0	4.0	30.0	76.0	87.0	100.0	88.0	65
Phenyl amino cadmium lactate (P. 177)	500 ppm	0.5	6.0	32.0	76.0	92.0	100.0	93.0	69
Disodium ethylene bisdithiocarbamate (Dithane D-14)	2 qts	1.0	2.0	22.0	75.0	88.0	100.0	149.0	77
Zinc dimethyl dithiocarbamate (Zerlate)	1½ lbs	0.7	7.0	37.0	80.0	89.0	100.0	141.0	79
2, 3 dichloro 1, 4 naphthoquinone (Phygon)	2 lbs	0.1	0.1	1.0	6.0	9.0	9.0	172.0	85
Lauryl isoquinolinium bromide (Isothan Q-15)	500 ppm	3.0	8.0	49.0	78.0	86.0	100.0	121.0	70
Cetyl isoquinolinium bromide (Isothan Q32)	500 ppm	0.6	6.0	29.0	72.0	80.0	100.0	130.0	74
Lauryl isoquinolinium chloride (Isothan Q90)	500 ppm	3.0	14.0	53.0	88.0	94.0	100.0	126.0	71
Lauryl isoquinolinium thiocyanate (Isothan Q-48)	500 ppm	4.0	12.0	50.0	85.0	97.0	100.0	118.0	69
Cetyl nicotinium thiocyanate (E R L 38)	500 ppm.	3.0	14.0	53.0	88.0	94.0	100.0	113.0	69
Ferric dimethyl dithiocarbamate (Fermate)	1½ lbs	1.0	2.0	23.0	59.0	83.0	100.0	152.0	81
Bordeaux Mixture	10-10-100	0.1	0.2	5.0	12.0	11.0	11.0	228.0	87
Control	—	4.0	22.0	61.0	87.0	93.0	100.0	118.0	68

*Difference necessary for significance at 5 per cent level ± 17 bu ; at 1 per cent ± 23 bu
Sprays were applied on the following dates 7/2, 7/10, 7/18, 7/23, 7/31, 8/8, 8/13, 8/22.

concentrations used are given in table 1 Eight applications of each fungicide were made at approximately weekly intervals from the 2nd of July to the 22nd of August, the sprays being applied with a single row 4-nozzle Arlington power sprayer at 300 pounds pressure, 150 gallons per acre. In addition to the fungicides, all treated and check rows received 2 applications of 5 per cent DDT micronized with Pyrax ABB, (10 pounds per 100 gallons of water) at the rate of 150 gallons per acre.

Blight was first observed on the 22nd of June The percentage of blighted foliage was estimated for each row at six different dates during the season. These estimates are shown in table 1.

The tubers were dug on the 29th of September. The entire row of each treatment was harvested and the total weight in pounds for each replicate converted to bushels per acre The yields of the treatments and the check plots were averaged and are given in table 1 For significance between treatments at the 5 per cent level and at the 1 per cent level, a difference in yield of 17 3 and 23 2 bushels, respectively, was necessary

1946 Field Trials

In 1946, there were 11 treatments on 4 randomized blocks each containing 5 rows 88 feet long All sprays were applied with a 10-row Bean power sprayer, 4 nozzles per row, at 400 pounds pressure, and at the rate of 150 gallons per acre Nine fungicidal materials were used on the dates indicated in table 2 The plots were treated with DDT on the 7th and 20th of June and the 9th of August at the rate of 1 pound 50 per cent wettable DDT, and on the 3rd of July and the 26th with 2 pounds 50 per cent wettable DDT per 100 gallons of water. One treatment received no DDT and no fungicide, and another received DDT only.

Blight was first observed on the 11th of July Again, the percentage of blighted foliage was estimated for the treated plots and for the controls at 4 dates during the season The averages are shown in table 2

The 3 middle rows in each block (approximately 0 018 acre) were harvested on the 4th of October and the yields converted into bushels per acre. The yield data were analyzed statistically and appear in table 2. For significance at the 5 per cent level and 1 per cent level,—a difference in yield of 53.4 and 71 5 bushels per acre, respectively, was necessary

Discussion

The low yields in 1945 resulted, partially at least, from the excessive amount of vine damage caused by the wheels of the one-row

TABLE 2.—1946 *Field trials with new fungicides*

Treatment	Conc per 100 Gal H_2O	Per cent of Foliage Blighted, Average of 4 Replicates				Average Yield Bu Per Acre	Per cent U. S. No. 1
		7/24	7/31	8/9	8/21		
Control (No DDT — No Fungicide)	—	4 0	18 0	96 0	100 0	203 0*	84
Control (DDT — No Fungicide)	—	2 0	19 0	81 0	100 0	195 0	86
Bordeaux Mixture	8-4-100	0 0	0 2	1 1	4 0	404 0	93
Tribasic Copper	4 lbs.	0 0	0 2	1 5	12 5	329 0	92
2, 3 dichloro 1, 4 naphthoquinone (Phygon)	½ lb	0 0	0 5	2 4	89 0	278 0	92
Zinc dimethyl dithiocarbamate (Zerlate)	2 lbs	0 5	1 0	5 0	68 0	282 0	93
Lauryl isoquinolinium bromide powder (Isothan Q-15)	1 lb.	0 5	0 8	50 0	100 0	190 0	89
Lauryl isoquinolinium bromide liquid (Isothan Q-15)	1 pt.	1 2	11 0	66 0	100 0	217 0	89
Phenyl amino cadmium lactate (P 177)	1 lb.	1 5	7 0	47.0	100 0	169 0	89
Phenol mercury acetate (P. M A S)	½ pt	0 0	6 0	27 0	99 0	196 0	87
Bis - (3, 5, 6 trichloro - 2 - hydroxy-phenyl) methane (G-11)	2 lbs	0 2	0 7	6 0	86 0	260 0	91

*Difference necessary for significance at 5 per cent level ± 53 bu , at 1 per cent ± 72 bu
Sprays were applied on the following dates· 6/20, 7/3, 7/11, 7/14, 7/26, 8/9, 8/15, 8/21, 8/26

sprayer, and from the necessity of making frequent trips through the plots with the tractor. This vine damage undoubtedly contributed to the increased amount of blight observed in comparison with adjacent plots. In 1945, only the Bordeaux-treated plots showed no perceptible increase in the amount of late blight after the last spray application. In addition to less vine damage, the more favorable growing conditions and the better insect control from more frequent applications of DDT contributed to the higher yields and larger tubers (per cent U S No 1) obtained in 1946 Bordeaux and Tribasic Copper prevented a noticeable increase in the amount of late blight in 1946 after the last spray had been applied Moreover, the plants sprayed with these materials were still partially green at digging time.

On the basis of yield, in 1945 plots treated with Bordeaux, Phygon, Fermate, Dithane and Zerlate were superior in the order given, to the plots receiving no treatment Bordeaux was significantly better than any of the other 12 materials tested. In 1946, Bordeaux again ranked first but Zerlate, Phygon and G-11 were also significantly better than the check treatments

In both seasons, less foliage injury was caused by the organic materials than by the sprays containing copper The failure of some of the chemicals to control late blight was due partially to the poor adherence of the sprays to the leaves. By comparing the control which received neither fungicide nor insecticide with the control which had received only DDT, it was evident that DDT possessed no fungicidal activity, although the chemically related G-11 proved to have fair fungicidal properties.

RETARDATION OF SPROUTING OF POTATOES BY CARBON DIOXIDE STORAGE

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Introduction

Considerable interest has been shown recently in the use of hormone-like chemicals for the inhibition of sprouting of potatoes during late storage in the spring. Pioneer work at the Boyce-Thompson Institute by F. E. Denny, John D. Guthrie and N. C. Thornton, which is

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described in volumes 9, 10, 11 and 12 of the Contributions of the Boyce-Thompson Institute indicated the potentialities of the hormone method for sprout retardation and its application was tested in Wisconsin, by Thomas and Riker (7); in New Jersey, by Daines and Campbell (2); and in New York by Ora Smith (6)

Studies of the influence of carbon dioxide (CO_2) on storage of fruits and vegetables have been numerous and among them several cite experiments on the influence of CO_2 on sprouting Kidd (5) using *non-dormant* potatoes found that 10 per cent CO_2 retarded growth of buds somewhat and 20 per cent CO_2 inhibited growth of the buds Braun (1), using both dormant and non-dormant tubers, found that sprouting was stimulated by CO_2 over a range of from 2 44 per cent to 20 2 per cent CO_2. Experiments with *dormant* potatoes which were directed primarily at causing sprouting indicated that low oxygen tension tended to stimulate sprouting and at normal oxygen tensions increasing CO_2 beyond 20 per cent CO_2 tended to decrease sprouting (8,9)

These latter studies were carried out at or near room temperatures Thornton (10) noted, during studies on the influence of CO_2 on oxygen uptake by non-dormant sprouting tubers at 25°C that the higher concentrations (35, 40 and 60 per cent) of CO_2 did retard the growth of the sprouts and caused some blackening of the tips of the sprouts.

Other studies (11,3) on sugar-starch transformations indicated that at room temperatures an increase in CO_2 concentration to 30 or 60 per cent increased sugaring, whereas at low temperatures (2° - 5°C.) the rapid sugaring which usually takes place at these temperatures may be inhibited by as little as 5 per cent CO_2 and that the inhibition persisted for as long as 90 days

The marked difference in behavior of potatoes in the presence of CO_2 at one temperature as compared with another, the tendency for CO_2 to be associated with sprout behavior and the contradictory information on the effect of CO_2 on sprout retardation at normal late spring storage temperatures (50° - 55° F) led to the investigation described below.

Experimental Procedure and Results

In the spring of 1945, on the 11th of April, non-dormant, Green Mountain, B-size, sound tubers were selected from a pile and placed in each of four wooden barrels. Each barrel was fitted with a gas inlet and an outlet tube to control the flow of gas and degree of aeration, with a sampling tube to permit extraction of a sample of the gases

within the barrel and with a thermocouple for indicating temperature within the barrel. Each barrel was also fitted with a window which permitted examination of the contents without breaking the seal The barrels were of such a capacity that they contained approximately eighty-five pounds of tubers. After sealing the barrels the following gaseous conditions were impressed upon them·

I Carbon dioxide gas was passed into the barrel from a compressed gas cylinder and air allowed to diffuse into the barrel in sufficient quantities to maintain approximately a mixture of 12 per cent CO_2 by volume with the oxygen and nitrogen being displaced proportionately.

II Carbon dioxide concentration of approximately 12 per cent developed and maintained by respiration of the tubers themselves and with sufficient aeration to prevent building up the CO_2 content beyond this value.

III. Carbon dioxide concentration of approximately 11 per cent built up by injection of CO_2 from compressed gas cylinder and then

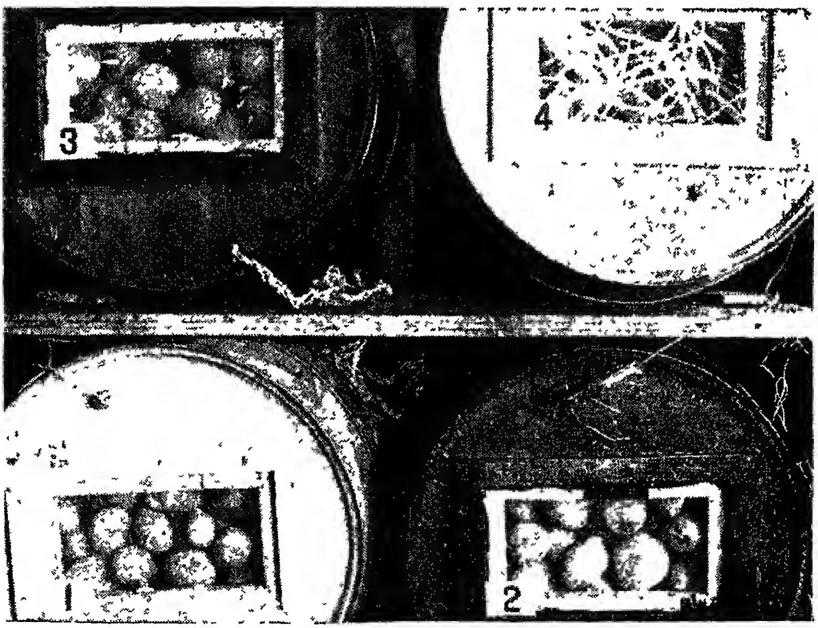

FIGURE 1. Degree of sprouting on June 8, 1945 when storage temperature had reached a value of 55° F.

Numbers 1, 2, 3, 4 refer respectively to treatments I, II, III, IV

Note how sprouts have completely filled the window area in the check treatment (No. 4) whereas the CO_2 treatments, 1, 2 and 3 have sprouted very little

maintained by respiration of the tubers together with slight aeration but with occasional further injections of CO_2.

IV. Carbon dioxide concentration of less than 1 per cent developed by respiration of the tubers in a barrel perforated with holes to permit fairly complete aeration.

The barrels were exposed to the prevailing storage room temperatures which ranged from 42°F. in April to 66° F. in July The temperature within the barrels was, in general, at or very slightly above the temperature of the storage room.

Carbon dioxide was determined daily and oxygen only intermittently using an Orsat gas analyzer Temperatures within the barrel were determined by means of a Leeds and Northrup potentiometer and the storage room temperatures from a mercurial thermometer.

The progress of the sprouting was observed through the windows of the barrels and a photograph taken on June 8 (Fig. 1). The temperatures in the barrels ranged from 50° to 55° F. between the 9th of May and the 8th of June and from 55° to 66° F between the 9th of June and the 7th of July

At the close of the experiment on the 9th of July the barrels were opened and the weights of sprouts determined (Table 1) As indicated in the table, the check treatment, No I, had a weight of sprouts which was 5 to 25 times as great as the various CO_2 treatments. The tubers from treatments I, II and III were smooth and firm and had short, stubby sprouts, whereas those from treatment IV were flabby and wrinkled and had long, vigorously growing sprouts

TABLE 1—*Preliminary experiment on CO_2 retardation of sprouting Green Mountain variety ** April* 11 *to July* 9, 1945

(Initial weight of tubers approximately 85 pounds)

Treatment Number	Average Per cent CO_2	Sprout Weight Lbs
I	12 5	0 33
II	11 8	0 30
III	11 2	1 58
IV	0 6	8 25

Random samples taken from the respective barrels were cooked and eaten to determine whether quality and flavor had deteriorated Those from the barrels with restricted aeration (II and III) had a musty odor and flavor but were fairly mealy Those from the more thoroughly aerated barrels (I and IV) had no off flavor or odor but

TABLE 2—*Carbon dioxide retardation of sprouting—Katahdin variety—March 18 to May 6, 1946.*

	Treatment	Average Per cent CO_2	Average Per cent O_2	Tubers + Sprouts (pounds) Original Weight	Tubers + Sprouts (pounds) Final Weight	Tubers + Sprouts (pounds) Per cent Loss	Sprouts Grams	Sprouts Per cent Original Weight	Total Loss Per cent	Specific Gravity*
I	Check	0 9	19 5	83 3	81 5	2.16	1677	4 44	6 60	1 0775
II	CO_2 supplied wholly by respiration	7 8	13 1	83 2	81 9	1 56	737	1 96	3 52	1 0768
III	CO_2 supplied from compressed gas cylinder with continuous flow	10 5	13 6	85 1	83 9	1 41	68	0 18	1 59	1 0780
IV		7 6	17 0	85 0	83 4	1 88	472	1,23	3 11	1 0779

*Average of 50 tubers.

those from treatment IV were somewhat soggy in texture while those from treatment I were fairly mealy.

The source of the off flavor and odor in II and III was thought to be the rotting tubers which were present in all four barrels. In barrels II and III these rot emanations accumulated, whereas in barrels I and IV they did not.

In 1946, further experiments were carried out using CO_2 gas as a sprout retardant and the gaseous method was compared with the hormone method using the methyl ester of alpha-naphthaleneacetic acid.*

Approximately 85 pounds of Katahdin potatoes, selected for freedom from bruises or other mechanical injury and grading as U. S. No 1 were placed in the same wooden barrels which were used previously The barrels were fitted as described above, sealed, and then placed into a specially constructed constant temperature box. The latter was heated with a greenhouse bed heating cable which was strung around the walls and maintained at a temperature of 52° ± 1° F. by means of a thermostatic switch.

Varying degrees of aeration and carbon dioxide concentration were then imposed on the potatoes in the respective barrels, shown in table 2

At the same time, in order to compare the carbon dioxide method with a chemical method of retarding sprouting, a peck of Katahdin potatoes was placed in each of three heavy paper bags and the potatoes in two of the bags treated with 0.9 grams and 0 45 grams of methyl ester of alpha-naphthalene acetic acid per bushel of potatoes The methyl ester was applied in the form of a Pyrax talc dust containing 0 4 per cent of the methyl ester The third bag was left undusted All three bags were then tied securely with twine and placed in the constant temperature box

After 49 days in the constant temperature box the degree of sprouting was determined and is shown in the following photographs and tables Figs 2, 3 and tables 2, 3

The data indicated that treatment III with an average CO_2 content of 10 5 per cent and an average of O_2 content of 13 6 per cent was most effective in retarding sprouting and was fully as effective as the hormone treatment in this regard

The second best gaseous treatment was No IV with an average of 7 6 per cent CO_2 and approximately 17 per cent. O_2 The shrinkage of the tubers in treatment IV was greater than in treatment II but the sprouting was sufficiently less to make the total loss somewhat smaller than in treatment II.

*Obtained through the courtesy of Merck and Co., Inc., Rahway, N J

FIGURE 2 1946 Experiment — CO_2 Retardation of Sprouting Degree of sprouting on May 7, 1946 after storage at 53° ± 1° F for 49 days No 1—check; No 2—7 8 per cent CO_2 supplied by respiration alone, No 3—10 5 per cent CO_2 and No 4—7 6 per cent CO_2, both supplied primarily by CO_2 from compressed gas cylinder Sprouts taken from approximately 85 pounds of tubers

FIGURE 3 Methyl Ester Hormone Retardation of Sprouting—after storage at 53° ± 1° F for 49 days No 1—check, No 2—0 45 grams hormone per bu ; and No 3—0 90 grams hormone per bu

The degree of sprouting of the check treatments in the barrels and in the peck bag were almost identical and approximately 25 times as great as the best gaseous treatment and 20 times as great as the best methyl ester treatment

TABLE 3.—*Hormone retardation of sprouting*

Treatment	Hormone Concentration Grams Bu	Sprouts Per cent of Original Wt
A	0 0	4 58
B	0 45	0 63
C	0 90	0 22

Both of the methyl ester treatments were more effective in retarding sprouting than the CO_2 treatments which had less than 8 per cent CO_2. The results during 1945 and 1946 indicated that a highly effective CO_2 concentration lay in the range of 10 to 12 per cent CO_2 and that short periods of several days with concentrations down to 8 per cent CO_2 or up to 14 per cent CO_2 did not seriously alter the effectiveness of the treatment

Cooking tests of random samples from the various barrels showed no off-flavors and the various tubers were equally mealy in texture. No rotted tubers were found in any of the barrels hence it is indicated that the method of gaseous storage when used with sound tubers does not induce rotting or death of the tubers

The sprout retarding action of the CO_2 treatment persists to a moderate degree after removal of the tubers to normal atmospheric conditions and further study of the effect of this persistence will be necessary before its use with seed stock can be recommended

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THE INFLUENCE OF SPROUT-INHIBITING AND SPROUT-INDUCING TREATMENTS ON THE GROWTH AND YIELDS OF POTATOES[1]

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INTRODUCTION

Excessive sprouting of stored potatoes intended for use as seed occurs in the potato region southeast of Buenos Aires, Argentina This region has a seven month period between growing seasons, extending through fall, winter and spring in which temperatures are moderate. These moderate temperatures make it difficult to keep tubers dormant after the end of the rest period

The recommended practice in this region has been to allow tubers to remain in the field until they begin to sprout The tubers are then stored in piles above ground and covered with straw The temperatures during mid-winter tend to restrict further sprouting. This is followed by a relatively long period of moderate weather with occasional frosts in late winter and early spring. During this period potatoes sprout excessively, resulting in decay and shrinkage The present study, conducted during the winter of 1944-1945, was made to determine if seed potatoes could be treated chemically to inhibit sprouting under storage conditions similar to those described above and subsequently treated with another chemical to promote sprouting and growth at planting time.

REVIEW OF LITERATURE

The literature on dormancy in potatoes has been reviewed by Rosa (12) and Smith (13) The earlier work on the use of plant

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hormones to inhibit growth of buds of various plants has been reviewed by Went and Thimann (15).

In relation to potatoes, Elmer (8) observed that sprouting was inhibited by the presence of ripening apples which, among other things, released ethylene gas into the atmosphere. Experiments on the use of chemicals for the prevention of sprouting in potato tubers were first reported by Guthrie (9), (10), (11) and Denny, Guthrie, and Thornton (5) Thomas and Riker (14) found that chemical treatments were effective on all potato varieties tested, including Chippewa, Cobbler, Red Warba, Russet Burbank, Russet Rural and Triumph

The hastening of sprouting of dormant tubers was studied by Appleman (1) who stimulated growth of sprouts by removing the periderm around the eyes and by mechanically injuring the tissue surrounding the eyes. He also employed several chemicals to break the rest period and reported the most satisfactory results with ethyl bromide. After Denny (2), (3), (4), published his experiments on the use of chemicals in hastening the sprouting of potato tubers, the literature on this phase has become very extensive. The practical applications of this mass of information have been condensed by Denny in a recent paper (7).

Studies pertinent to the work reported in this paper were made by Denny (6). He presents results on germination in the spring of tubers treated over winter with methyl ester of alpha naphthaleneacetic acid, with and without chemical treatments to break dormancy Denny states the results of his experiment as follows. "Tubers removed from the treatment bins in March to May, 1942, cut into pieces and planted in soil, germinated poorly, especially in the lots treated with methyl ester at a rate of 100 milligrams per kilogram, and with less than 50 per cent of germination with lots treated with 33 milligrams per kilogram Washing the treated tubers with soap and water favored germination Treatments with ethylene chlorhydrin or combinations of treatments with ethylene chlorhydrin and sodium thiocyanate or thiourea brought about further improvement in germination. However, even then, complete germination of sprouts was not obtained It is believed that the sprout dormancy induced by the vapor of methyl ester of naphthalene acetic acid is more pronounced than that which occurs in the natural rest period of the tubers of this variety of potatoes"

Materials and Methods

The general procedure was to maintain dormancy by what seemed to be the most effective chemical treatment reported. Then after three months of storage to break the dormancy with the well-known ethylene

chlorhydrin treatment, plant the tubers in the field and record the germination, vine growth, and yield.

The experiment was a factorial involving the following treatments

1. Two varieties: Triumph and Cobbler
2. Three treatments to prevent sprouting
   - A Dusting with methyl ester of alphanaphthaleneacetic acid at a rate of 20 milligrams per kilogram of potatoes The methyl ester diluted with acetone was mixed with talc at the rate of 20 milligrams of the methyl ester to 1.65 grams of talc After the mixture was dry it was ground in a mortar to a fine dust This will hereafter be referred to as the "dusted" treatment
   - B Spraying tubers with Fruitone 46, a commercial preparation consisting of an alcohol solution of ethyl naphthyl acetate, so as to wet them thoroughly This treatment will hereafter be referred to as the "sprayed" treatment.
   - C No chemical treatment. This will be referred to as the "check" treatment
3. The potato samples were stored at two temperatures
   - A 68° - 82° F
   - B. 50° - 55° F.

All treatments were made in duplicate using eight-pound lots of tubers placed in tin containers

The chemicals were applied on the 17th of January Tubers were examined at 7 to 9-day intervals to determine the per cent of sprouted tubers On the 1st of May, one kilogram of potatoes from each sample was desprouted and the weight of the sprouts recorded

On the 26th of April, in order to break the dormancy, all samples of one replicate were treated with 40 per cent ethylene chlorhydrin solution at the rate of 1 3 cc per cubic decimeter of the container for 24 hours On the 28th of April samples from all lots were planted in the field in a split-plot arrangement The main plots were set aside for varieties; these were divided for temperature and then subdivided for the six different treatments The emergence was recorded at weekly intervals from time of planting In mid-season the number of stems per seed piece, and at harvest the yield per plant, was recorded

Results of Treatments to Prevent Sprouting

The effects of the dormancy treatments and storage temperatures on the development of sprouts on the varieties Triumph and Cobbler are shown in table 1. Figures 1 and 2 show the appearance of samples of tubers of Triumph and Cobbler, respectively, 98 days after treatment

TABLE 1.—*Percentages of tubers sprouted on indicated dates after having been treated on January 17 with: (1) talc (check), (2) Fruitone #46 (sprayed), or (3) methyl ester of naphthaleneacetic acid (dusted)*

Dormancy Treatment	Storage Temperature	Total Per cent Tubers Sprouted on Indicated Dates: 1/25	2/1	2/8	2/15	2/23	3/1	3/9	3/19	3/29	4/7	4/16	4/26	Wt of Sprouts from 1 Kg of Pot on 5/1
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Mgms
		Variety: Triumph												
1 Check	68-82° F	10.4	75.3	100.0										77
	50-55° F	0.0	4.4	6.6	16.2	34.8	53.7	90.6	100.0					42
2 Sprayed	68-82° F	2.3	37.0	67.7	75.7	82.6	88.6	100.0						52
	50-55° F.	0.0	2.9	2.9	14.0	22.4	32.4	70.8	74.3	86.3	100.0			41
3 Dusted	68-82° F	1.0	1.0	3.8	12.4	12.4	12.4	16.6	37.6	39.6	41.5	42.4	44.2	Too small to be desprouted
	50-55° F	0.0	2.9	2.9	6.8	8.4	9.8	23.2	30.2	47.8	58.4	68.6	70.4	
		Variety: Cobbler												
1 Check	68-82° F	22.7	95.8	100.0										84
	50-55° F	3.1	23.4	23.4	63.8	73.3	80.3	100.0						20
2 Sprayed	68-82° F.	16.0	63.1	91.3	94.8	97.4	100.0							59
	50-55° F	0.0	8.0	8.0	10.2	14.1	20.2	46.4	61.9	71.7	80.8	100.0		5
3 Dusted	68-82° F	12.4	18.6	30.0	30.0	30.0	31.3	41.2	48.0	48.0	48.0	48.0	50.4	Too small to be desprouted
	50-55° F	0.0	21.5	22.8	32.2	35.0	38.8	63.6	72.4	80.2	80.2	100.0		

With both varieties the "dusted" treatment was more effective in inhibiting sprouting than was the "sprayed" treatment. The data in table 1 also show that, with both varieties the "dusted" treatment was more effective at the high temperature storage (68 - 82° F.) than at the low temperature storage (50 - 55° F.). This was probably due to more rapid and more complete vaporization of the naphthaleneacetic acid ester at the higher temperatures

The weights of sprouts removed from one kilogram samples of all lots of dusted potatoes 99 days after treatment were too minute to be easily measured. "Sprayed" potatoes in the same period of time produced almost as much sprout growth as did the untreated potatoes

Results of Treatments to Induce Sprouting

On the 26th of April, 99 days after sprout-inhibition treatments had been applied, all samples of one replicate were treated with 40 per cent ethylene chlorhydrin to hasten sprouting. On the 28th of April, tubers from all treatments were planted in the field in order to observe the effect of the various treatments on rate of emergence, stand, number of stems, and yield.

Plant Emergence.

Plants began to emerge from the soil on the 23rd of May,—25 days after planting Figure 3 diagrammatically shows the number of emerged plants at intervals from the 23rd of May to the 23rd of June as an average of the two varieties grown in the test.

The emergence of the unsprayed, undusted potatoes was most rapid Treating such tubers with ethylene chlorhydrin delayed emergence slightly.

Those tubers which had been sprayed or dusted with sprout-inhibiting materials were the slowest to emerge. However, treating such tubers with ethylene chlorhydrin hastened emergence and also significantly increased the final stand from 77.3 per cent to 94.7 per cent for the "sprayed" tubers and from 74.7 per cent to 97.3 per cent for the "dusted" tubers.

As is apparent from figure 3, tubers having chemically induced dormancy can give as good a stand when planted as untreated seed tubers provided the former are chemically treated to induce sprouting before being planted. However, it took approximately 20 days longer for the "sprayed" or "dusted" tubers to produce a maximum of plants than did the untreated tubers. As will be discussed below, this delay in emergence is reflected in final yield of tubers.

Number of Stems (Plants) per Seed Piece:

The average number of stems per seed piece for each treatment are given in table 2. Tubers which had been sprayed or dusted to in-

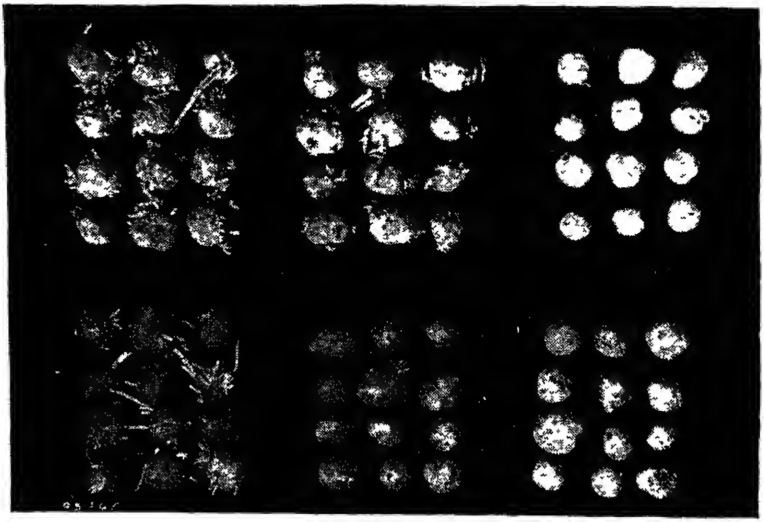

FIGURE 1 —Triumph potatoes on April 25, 1945. 98 days after application of treatments to inhibit sprouting. Upper groups tubers stored at 68-82 F , lower groups tubers stored at 50-55 F. Left untreated tubers, center · tubers sprayed with Fruitone 46; right tubers dusted with methyl ester of naphthaleneacetic acid

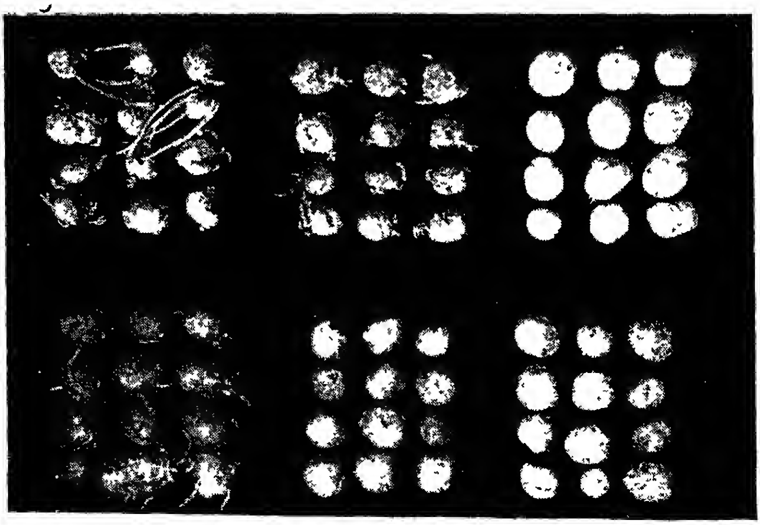

FIGURE 2 —Cobbler potatoes on April 25, 1945. 98 days after application of treatments to inhibit sprouting. Upper groups tubers stored at 62-82 F ; lower groups. tubers stored at 50-55 F Left untreated tubers; center, tubers sprayed with Fruitone 46, right tubers dusted with methyl ester of naphthaleneacetic acid

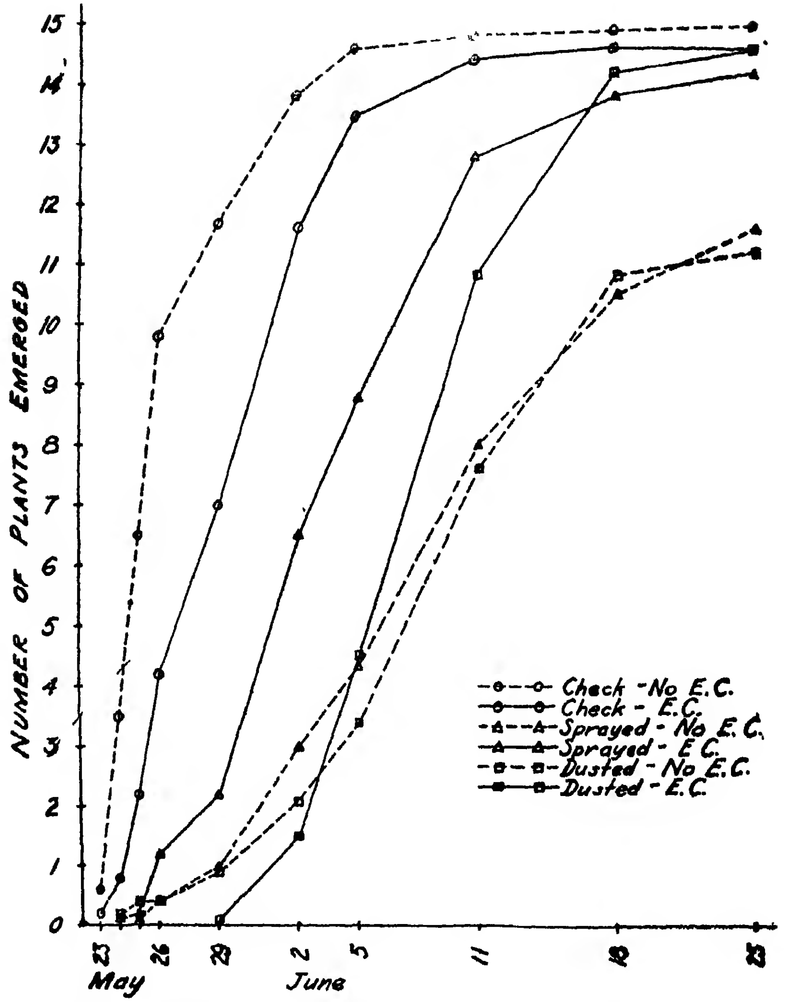

FIGURE 3—Emergence of plants from planted seed pieces of tubers which had received (1) no treatment (check), (2) Fruitone 46 (sprayed), or (3) methyl ester of napthaleneacetic acid (dusted) to inhibit sprouting followed by treatment with ethylene chlorhydrin (E C) or no ethylene chlorhydrin (no E C) to induce sprouting.

hibit sprouting produced significantly fewer stems when planted than did untreated tubers Tubers treated with ethylene chlorhydrin to induce sprouting produced a significantly larger number of stems than did tubers not treated with ethylene chlorhydrin regardless of previous treatment.

TABLE 2.—*Numbers of stems per seed piece after indicated sprout-inhibiting and sprout-inducing treatment*

Numbers of Stems in Indicated Classes				
Dormancy Treatment	Treated with Ethylene Chlorhydrin	Not Treated with Ethylene Chlorhydrin	Mean	Diff Nec for Odds of 19:1
	(Number)	(Number)	(Number)	
Check	6.1	4.4	5.2	0.8
Sprayed	3.7	1.6	2.7	0.8
Dusted	2.5	1.7	2.1	0.8
Mean	4.1	2.6		0.4
Difference necessary for odds of 19:1	0.8	0.8	0.5	

Yield of Tubers:

The average yields in pounds per hill obtained with different combinations of treatments are given in table 3.

TABLE 3.—*Yields per hill from seed tubers after indicated sprout-inhibiting and sprout-inducing treatments*

Dormancy Treatment	Treated with Ethylene Chlorhydrin	Not Treated with Ethylene Chlorhydrin	Mean	Diff Nec for Odds of 19:1
	(Pounds)	(Pounds)	(Pounds)	
Check	1.48	1.32	1.40	0.32
Sprayed	1.26	0.87	1.06	0.32
Dusted	0.95	0.91	0.93	0.32
Mean	1.22	1.03		0.18
Difference necessary for odds of 19:1	0.32	0.32	0.22	

Tubers which had been sprayed or dusted to inhibit sprouting produced significantly lower yields when they were not treated with ethylene chlorhydrin to induce sprouting before planting. "Sprayed" tubers

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• Where else but in Maine will you find seed strains to match our yield records, year after year? Take the 1946 crop. Maine's average seed potato yield, from 45,000 Certified acres, was over 400 bushels per acre. *Mind you that's an average-400 bushels per acre from 45,000 acres.*

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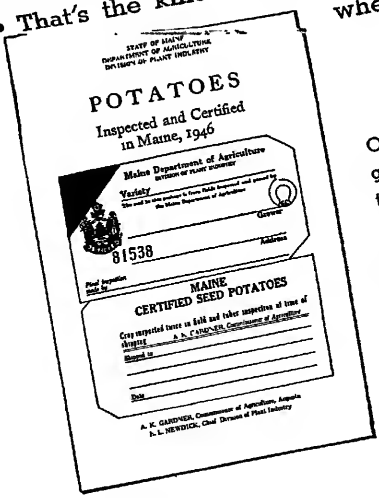

Our acreage on all these popular varieties was good. We can, of course, also supply some of the less popular varieties.

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which were treated to break dormancy yielded almost as much as the untreated checks The "dusted" tubers, however, which had fewer and smaller sprouts at time of planting did not recover from the sprout inhibiting treatment rapidly enough to overtake the growth of untreated plants even when treated with ethylene chlorhydrin. It is possible that an earlier treatment to break the chemically induced dormancy of such tubers would result in yields equally as high as those untreated tubers

Summary and Conclusion

(1) Triumph and Cobbler seed potatoes were (a) dusted with the methyl ester of naphthaleneacetic acid at the rate of 20 milligrams per kilogram of potatoes, or (b) sprayed with a commercial preparation containing ethyl naphthl acetate. Lots of each group were stored at two temperatures, 50 - 55° F. and 68 - 82° F.

(2) Just before planting, one-half of the tubers from each of the tubers of the above lots was treated with ethylene chlorhydrin to induce sprouting.

(3) Tubers dusted with methyl naphthaleneacetic acid produced on measurable weight of sprouts in 99 days, whereas tubers which had been sprayed and tubers which were untreated sprouted freely during the same period.

(4) When planted in the field, tubers which had been treated to inhibit sprouting were slow to emerge. Forty-five days after planting the sprouts on only 75 per cent of such seed pieces had emerged from the soil The plants had a relatively low number of stems per hill and produced a relatively low yield per hill.

(5) Tubers which had previously been treated to inhibit sprouting, when treated with ethylene chlorhydrin just prior to planting sprouted more rapidly than did the comparable untreated tubers. The final stand from tubers treated with ethylene chlorhydrin, was equally as good as was attained from tubers which had not been subjected to any chemical treatments. Treatments with ethylene chlorhydrin also resulted in more stems per hill and increased yields

(6) Seed tubers which had been chemically treated to inhibit sprouting when treated with ethylene chlorhydrin to induce sprouting did not produce as high yields as did seed tubers handled in the usual manner However, the data obtained indicate that proper timing of the dormancy-breaking treatment may result in yields equally as good as those obtained from normal seed tubers

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SECTIONAL NOTES

ALABAMA

Planting of the spring crop of Irish potatoes in the commercial section of Alabama started during the week of January 27. It had been expected that considerable acreage would have been planted before this time but wet weather prevented the preparation of the land. With a few days fair weather planting will be pushed to the limit It is expected that most of the seed will be in the ground before February 15

It now seems that there will be about 300 cars of seed planted in the commercial crop. Figuring about 55 acres to the car or about 8 bags of seed to the acre, we can expect the total crop to be near 17,000 acres There will be better than 80 cars of this seed of the Sebago variety or almost one-third of the total planting There are indications that some of the growers will plant their Sebago seed first instead of last

as in previous years The fertilizer situation is acute but somehow enough will be made available to plant the Irish potato crop even if other crops are shorter later on The estimated planting of 17,000 acres in the commercial planting of Irish potatoes gives about a 25 per cent reduction in this year's crop Most of the potato growers will be in a position to meet requirements for the support program.

The quality of the seed has been very good this year so far as size and condition at time or arrival are concerned. Most of this seed was secured from Certified Growers who have sold seed in this area with a reputation of good potatoes We think that our growers have the "Cream of the Crop" for their seed

Planting of 170 test samples and some 20,000 index tubers will get under way at the Gulf Coast Substation at Fairhope this week Another extensice blight experiment will be carried this year together with several tests for observation in different places over the area. (Feb 3)—FRANK E GARRETT

INDIANA

It is apparent that the potato situation is a rather touchy subject at this time and, of course, the disposition of the surplus potatoes and the cost of the government being printed in most of the state and local papers was not the best publicity Trying to hold the price up and forcing people to eat potatoes is not the way of the American public

Although we have received no official notice, there is some talk in our state of increasing our acreage approximately 6-10 per cent above last year's crop, in hopes that we can relieve the transportation of potatoes from various other sections into Indiana We have no complaints to offer with reference to our growers They are doing a very good job We are getting some well graded and high quality and also well-packaged potatoes in our stores, and this will mean that it will be harder for other sections to ship into our state unless they meet the same qualifications or have something better (Jan 27)—W B WARD

MAINE

The outstanding event at present is the disposal program of the Federal Government in dealing with the big surplus with which we are all faced About February 1st authorization was given to dispose of eleven million bushels of potatoes in addition to the previous commitments of a rather indefinite amount of several million bushels that had been showing spoilage This is also in addition to potatoes being ground for a starch and shipments for export.

This quota of eleven million bushels exceeds slightly the amount offered by growers up to February 1st as an accumulation of their monthly 20 per cent quotas. To those who are "horrified at the waste" involved, it might be well to point out that the waste came in producing this surplus and not so much in disposing of it It was a waste of man-power, soil resources, seed and fertilizer but no one could foresee that, as the acreage in 1946 was the lowest in more than 25 years

If manufacturers waste raw material or freeze production the public thinks nothing of it When farmers attempt to face their problems on just as realistic a basis a great human cry goes up from the public on dumping potatoes and killing little pigs. Farm income must not be allowed to decline so drastically as to produce the chaos we had in the 20's and 30's even if some serious measures have to be adopted It is the hope of farmers here and elsewhere that stand-by plants can be set up to use this surplus in those years when it is apparent that a surplus exists That is a better solution

Potatoes are being exported to Portugal, Spain, Albania, Italy and the UNRRA will also be taking some volume Markets are showing more action under the stimulus of the reduction of the overwhelming surplus It is hoped that sufficient enthusiasm will enter the deal so that the trade will be able to handle potatoes profitably There has been no speculative interest or enthusiasm whatever thus far and there is considerable evidence to indicate that such a depressed attitude inevitably results in decreased sales and consumption.

Growers in Maine are almost universally ready to cooperate in a program curtailing acreage Individual allotments are now being set up The Florida readings on our seed samples this year have been the best that Maine has ever sent Our seed trade will be getting foundation seed in many cases, and the quality as a rule is better than we have sent out before. This should meet with the favor of our seed customers throughout the eastern half of the United States Never before has so much good seed been available and we are taking steps to spread this best seed among our own table stock growers in every way possible

There is much discussion of an increase in the advertising tax Growers are now paying one cent per barrel on all potatoes shipped and there is much interest in doubling this amount making a total of two cents per barrel After all this is a pretty small investment in relation to the value of our crop and the need for improving the distribution and consumption of our product However, steps are being taken to set up a research administration in marketing to comply with the provisions of the Flannigan-Hope Bill We are jealously watching these funds to

see that they be kept in marketing only and not diverted under clever guises to additional production experiments Information in marketing is the great need today Facts on marketing are limited because of lack of research in the past. (Feb 7)—FRANK W HUSSEY

NEBRASKA

The movement of seed and table potatoes from western Nebraska shipping points has been about normal for the time of the year The movement, however, is not sufficiently heavy, considering the large crop that was grown, and shippers expect that there will be a hold-over in the spring as a result.

The Government program of disposing of surplus potatoes has been in operation though in a small way to the present time The actual dumping of potatoes has not gotten under way, although a substantial proportion of our crop is expected to be disposed of in this manner

Prices for table stock have been about at support, and, occasionally, below support prices Seed potatoes have sold at a fair margin above support, although many growers feel that the price was not high enough to cover cost of production this season. Costs of production were excessive,—particularly at harvest,—because of very adverse weather conditions, and a prolonged harvest season

The prospects for planting this coming year are nebulous at this time Probably some voluntary reduction in acreage should be expected because of the poor prices and difficulty of disposing of this year's crop Actually, the production goals set up by the AAA are about the same as last year, in view of the fact that Nebraska production has been down for several years Certified seed production is expected to be curtailed somewhat because of the extremely large crop of last year, and the difficulty of selling this year's crop The total tonnage of certified seed sold to date actually exceeds that of previous good years, but the very large crop still means that there is a considerable amount in growers' cellars at this writing, though the movement is still fairly active. (Feb 7)—MARX F KOEHNKE

NEW JERSEY

The Thirtieth Annual Meeting of the New Jersey State Potato Association was held Thursday and Friday, the 23rd and 24th of January and was one of the best attended in many years Three hundred and fifty potato growers and others interested in the potato industry attended the Thursday session, and more than one hundred the Friday morning session The Potato Association's Banquet and dance held

Thursday evening was also a great success with approximately two hundred and fifty persons present

Potato growers are receiving their acreage allotments for 1947 with mixed feelings Some growers are seeking to have their allotments increased, whereas others are accepting the 20 per cent cut as inevitable and a necessary action if production is to be brought in line with consumption

This is a year when every grower should plant certified seed only, since so much of it is available at very reasonable prices No grower should take a chance on selected seed for the sake of saving a few cents, when both certified and foundation seed are so plentiful and can be obtained at so reasonable a price

Numerous New Jersey growers have started to cut their seed for spring planting and many of them have most of their fertilizer supply on hand Fertilizer is not very plentiful and growers may find that they will not be able to get the analysis they want when the planting season opens in late March

Many growers are planning to use benzene hexachloride on a portion of their potato acreage This insecticide gave outstanding control of wireworms in experiments conducted by the New Jersey Agricultural Experiment Station last year, but it will not be recommended for general use until further experimental work is conducted Our growers have been cautioned to use the material sparingly and only on a very limited acreage since its use is entirely in the experimental stage (Feb 10)—J C CAMPBELL

NEW YORK

The potato business in up-state New York is continuing on an even demoralized keel Even, because it has been this way all winter and demoralized because there are so many different prices and grades No 1 table stock, for instance, may vary 75c cwt. in different localities depending on whether it is utilized locally or shipped out of state Many growers are under the government plan and are holding for the support price but many others are selling at the market which is approximately $2 10 cwt figuring that they might better move them now than to wait until spring

The recent announcement that growers could dispose of their so-called fringe sizes and deteriorating lots at once has tended to put more confidence in the market and the program But by the time this news note is printed it may be a different story.

Seed potato growers in this area are much concerned about the

recent announcement by the government showing a big crop of certified seed potatoes The statistics were gathered last fall and do not apply to the present situation Many growers have sold their certified seed because they ran so large it would not pay to grade out the seed size and several lots have been turned down, since last fall because of bin infection and the Florida test. Our growers claim that there will not be enough good seed to meet the demands

New varieties are in quite some demand All stocks of the blight immunes, Empire, Placid, Virgil and Essex are covered by orders At the present time there are a few Eries left This variety seems to be replacing Katahdin in some sections.

At the recent meeting of the Empire State Potato Club and other sessions at which problems have been discussed there has been a tendency toward a future plan based on marketing agreements with facilities for utilizing low grades. It is felt that support money could better be utilized for facilities than in the way it is being handled. (Feb 3)--H J EVANS

NORTH CAROLINA

Our commercial early Irish potato growers have indicated that they intend to plant 29,000 acres in 1947 which is 15 per cent less than was harvested in 1946. The report is based on an "intentions to plant" survey conducted by the Federal-State crop-reporting service, and is 18 per cent less than the ten-year (1936-1945) average (Feb 5)—M E GARDNER

OHIO

The potato market is very dull. The holding of potatoes is somewhat larger than it was a year ago, but most of the potatoes now available are Russets and the markets do not want this variety Russets are grown chiefly for the chipping market, but the variety is not chipping white this year.

The potato acreage in Ohio was cut one-half during the war period The acreage was reduced from around 120,000 acres to nearly 56,000 and Ohio has been given approximately the same acreage that they had a year ago, therefore, there has not been much activity at the present time to reduce acreage further, but I am informed by the AAA office that growers are not coming in to sign up under the support program next year A letter to the potato growers has informed them about the support program and the necessity for signing up if they desire support in 1947 and 1948. This may stimulate the sign-up (Feb. 5)—EARL B TUSSING

PENNSYLVANIA

A recent visit to a number of potato storages in the principal seed potato growing region of Pennsylvania revealed some rather encouraging results in regard to the keeping quality of the certified seed crop Growers are finding the seed crop is storing much better than they had anticipated earlier in the storage period. Even though a few lots of seed show considerable break-down, most of the certified stock is apparently keeping much better, in storage, than was expected

Our seed growers also report a very light inquiry and poor demand for seed, with prices ranging from $2.90 to $3 25 per cwt at the growers' cellar.

The Pennsylvania Farm Show was held at Harrisburg during the week, January 13 to 17 inclusive It was estimated that a total of 540,000 people attended the show during the five-day period. The week was also devoted to Farm organization meetings, which, of course, included the Potato Growers. Their two-day meetings, as well as the commercial machinery displays, attracted a large number of interested potato growers New developments in potato growing machinery that was of special interest, were the new Oliver TNT plow and the John Bean potato harvester

The Potato Banquet was attended by more than 400 persons, at which time 83 new growers were presented for membership in the "400 Bushel Club." The highest potato yield reported for 1946 for the state was 782 bushels grown by J E Grove & Son of York County This acreage was measured and one-tenth of the area was dug and weighed from the measured acre It is believed that this is a record yield for unirrigated ground The variety grown was the Russet Rural (Jan 24)—K W LAUER

RHODE ISLAND

Potato growers are making plans for an exhibit at the Southern New England Farm and Home Show, to be held in Providence from the 25th of February to the 1st of March Their purpose is to boost Rhode Island grown potatoes Plans are also under way to form a state-wide organization,—the purpose of which is to help solve the mutual problems of the potato growers A meeting has been held in each of the potato-producing areas, where considerable interest was shown and committees were appointed

The task of assigning allotments to the growers has been completed On the whole, they have been very well accepted However, there is some feeling among growers that they should not have received

a 15 per cent cut when the neighboring states of Massachusetts and Connecticut received practically no cut The feeling seems to be that this is still a deficit state,—producing only about two-thirds of its potato requirements, and therefore it should not be cut as much as some of the surplus states However, it is anticipated that cooperation will be nearly 100 per cent.

There is still a large surplus of potatoes to be moved I understand that a number of cars have been loaded recently for overseas shipment It is hoped that this outlet will continue, as this not only helps move the surplus, but also helps feed some hungry people that really appreciate food.

Reports from dealers indicate that seed and fertilizer orders are far behind normal for this date However, now that allotments have been made, they expect a rush of orders (Feb 5)—AVERY E RICH

WASHINGTON

The first results from out-of-door potato test plots have been distributed to the White Rose growers These results indicate that the growers are making good use of testing to eliminate virus-infected planting stock.

From all indications, compared with last year, there is less than one-half of the disease showing this year We realize that D D T was quite an important factor in holding the various virus vectors in check and that the combination of thorough roguing, regular dusting and seed selection by plot or greenhouse testing is the answer to many of the seed growers' problems

These early-tested lots were those that were eligible for foundation stock, but were held up for test plot results. The tests indicated that 57 per cent of these foundation lots showed no disease One lot showing 1 38 per cent Mosaic was the only lot showing a total disease of more than 1 1 per cent We feel that this record of low disease readings is excellent and that the present program is accomplishing a great deal to build up the quality of planting stock Certification officials and growers will be in attendance at the Plot Day held at Oceanside, California, —the week of the 23rd of February. (Jan 31)—HAROLD S. SCHAAD

CANADA

The Great Scot potato, which originated in Scotland in 1906, has given good results in British Columbia It has demonstrated that it is quite resistant to virus diseases, late blight and Rhizoctonia, over a period of six years It was grown by eight growers in 1946,—scattered

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over the province,—and inspected by six different inspectors All crops inspected, passed as Foundation or Foundation A grade of seed It is a second early or early main crop

The Great Scot variety is immune to wart disease, is a good keeper, of good quality and a heavy yielder Several reports have been received of yields ranging from 50-1, up to and exceeding 100 to 1 pound planted. (Feb 7)—E. R Bewell.

American Potato Journal

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NEW BRUNSWICK, N J

COMPARATIVE DRY-MATTER CONTENT OF VARIETIES OF IRISH POTATOES GROWN IN LOUISIANA[1]

E. L LECLERG[2]

United States Department of Agriculture, Baton Rouge, La.

High dry-matter content of tubers of Irish potatoes is important in the South, not only from the standpoint of better cooking quality, but also because such tubers keep better in storage and are more generally satisfactory for seed purposes than those of low dry-matter content

Therefore, a survey of the dry-matter content of ten commercial varieties was made at Baton Rouge, Louisiana in 1944 and 1945.

METHODS AND MATERIALS

Each year ten varieties were arranged in a randomized-block experiment consisting of 3 replications with plots 25-hills in length At harvest, duplicate 5-tuber samples were taken from each plot for determination of dry-matter content

The tubers of each sample were thoroughly wiped to remove dust. Each tuber was cut in half and one-half of each sample was grated over a kitchen vegetable grater. The resultant mass of fine pulp was thoroughly mixed and 10-gram samples of the pulp were weighed into tarred metal cans equipped with tightly fitting lids. Enough 95-per cent alcohol was added to each sample of pulp to cover the mass. The

[1]Cooperative investigations between the Division of Fruit and Vegetable, Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, and the Louisiana Agricultural Experiment Station.

[2]Pathologist, United States Department of Agriculture; stationed at Baton Rouge, Louisiana

samples were then placed in a drying oven for 48 hours after which they were reweighed and the dry weight determined .

Experimental Results

The dry-matter content of the 10 varieties in 1944 and 1945 are given in table 1 and figure 1.

Table 1.—*Percentage dry-matter content of* 10 *varieties of Irish potatoes at Baton Rouge, Louisiana, in* 1944 *and* 1945.

Variety	Percentage Dry-Matter Content		
	1944	1945	Average
Green Mountain	20.5	22.4	21.4
Sequoia	19.7	20.9	20 3
Irish Cobbler	19.3	19.2	19.3
Red Warba	18.4	19 4	18 9
Katahdin	17.5	19.8	18.6
Kasota	18.6	18.5	18.6
Warba	18 0	19 2	18.6
Triumph	17.9	17.7	17.8
Chippewa	17.8	16.9	17.3
Pontiac	17.2	16.9	17.1
Difference required for significance	1.2	1.3	0 8

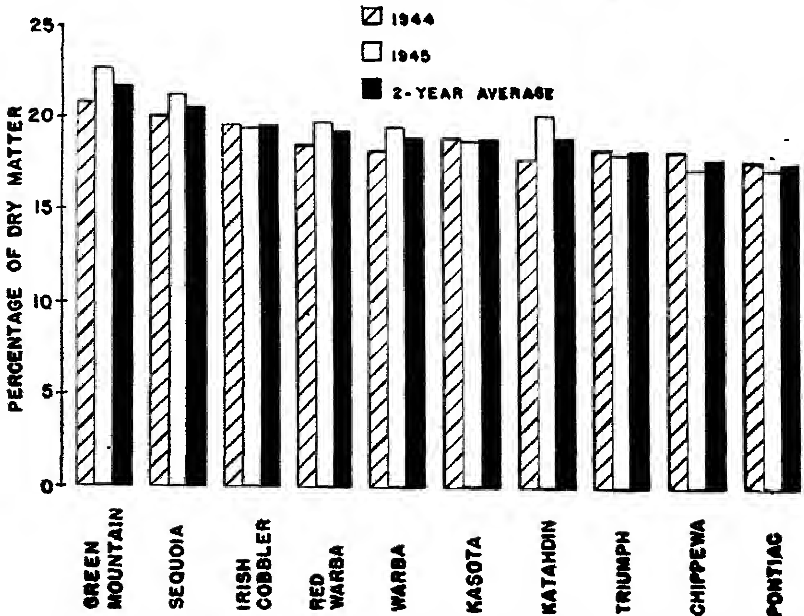

Figure 1. Percentage of dry matter on 10 varieties on Irish potatoes at Baton Rouge, Louisiana in 1944 and 1945.

Analysis of the combined data for the 2 years (table 2) indicates that highly significant differences exist between varieties, years, and the interaction of varieties x years. Thus, some varieties behave in a differential manner with regard to the influence of environmental conditions on the percentage of dry-matter.

Green Mountain and Sequoia were not significantly different in 1944, but in 1945 Green Mountain was superior to all other varieties in having higher dry-matter content. It is of interest to note that Green Mountain, which possesses high dry-matter in areas where it is grown commercially in the North, was also high in the more humid climate of Baton Rouge, Louisiana.

As an average of all 10 varieties the average dry-matter content in 1945 was significantly higher than it was in 1944. However, all varieties did not behave the same in both years as is indicated by the highly significant value of "F" for the interaction of varieties x years (table 2).

TABLE 2.—*Analysis of variance of dry-matter content of* 10 *varieties of Irish potatoes grown at Baton Rouge, Louisiana, in* 1944 *and* 1945.

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Replications within tests	4	1 561		
Varieties	9	94.187	10.465	20.24**
Years	1	5.766	5 766	11.15**
Varieties x years	9	15.416	1.713	3 31**
Error	36	18 607	0 517	
	59	135 537		

**Value of "F" exceeds the 1 per cent point.

The fact that the variance for varieties is significantly greater than that for the interaction of varieties x years (table 2) indicates that some varieties are significantly better than others as an average of the 2 years. Thus, the dry-matter content of Green Mountain was significantly higher than any of the other varieties in the test. Likewise, Sequoia was better than any of those below it in the table.

SUMMARY

A study was made to determine the dry-matter content of 10 commercial varieties of Irish potatoes at Baton Rouge, Louisiana, in 1944 and 1945.

Analysis of the data demonstrated that a significant interaction of

varieties x years existed, indicating that some varieties behave in a differential manner with regard to the influence of environmental conditions on the percentage of dry matter.

Green Mountain, under the humid conditions where the tests were made, was of the highest dry-matter content as an average for the two years.

A COMPARISON OF CERTAIN POTATO SPRAYS IN DIFFERENT LOCALITIES IN WEST VIRGINIA[1]

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AND

J. G. Leach

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Introduction

West Virginia has greatly varied conditions of rainfall, temperature and topography. Since potatoes are grown in all regions of the state, spray materials must be usable under these varied conditions The altitude of arable land above sea level varies from 500 to 4000 feet, and the distance from the northernmost point in the state to the southernmost point is about 250 air-line miles. In some localities late blight is found in epiphytotic proportions every year, whereas in other localities it occurs annually but not always in epiphytotic proportions, and in still other localities its occurrence is sporadic.

The practice of spraying and dusting potatoes is increasing throughout the state, Bordeaux mixture and copper-lime dust are in common use If a material with the adaptability and effectiveness of Bordeaux could be found which would be easier to use, it would have a much wider use than Bordeaux now has, and the control of late blight would be greatly extended. For these reasons tests are being conducted to determine if such a compound exists or will be brought into existence by the manufacturer of chemicals.

Materials and Methods

Materials for the test were furnished by various commercial concerns fixed copper and copper sulfate by the Tennessee Corporation,

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[1]Published with the approval of the Director of the West Virginia Agricultural Experiment Station as Scientific Paper No 363

[2]Assistant Plant Pathologist, and Plant Pathologist respectively West Virginia Agricultural Experiment Station

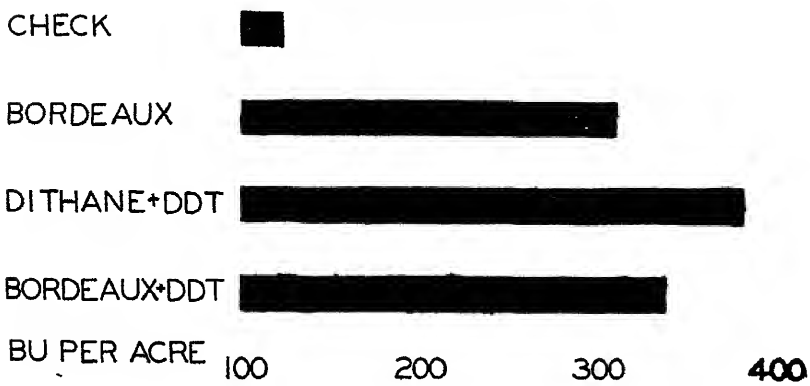
Dithane and Dithane HE 178E by Rohm Haas & Company, DDT by the Dupont Company, and the exploratory chromate compounds by the Carbide and Carbon Chemicals Corporation The Bordeaux mixture used was of the 8-8-100 formula, DDT at the rate of ¾ pounds actual DDT per 100 gallons of spray, and other chemicals were used at the recommended rates

Tests were made in four, five and six row plots, 60 feet long,—replicated four times The results presented here are from two years' tests in one locality, and one year's test in two other localities.

Experimental Results

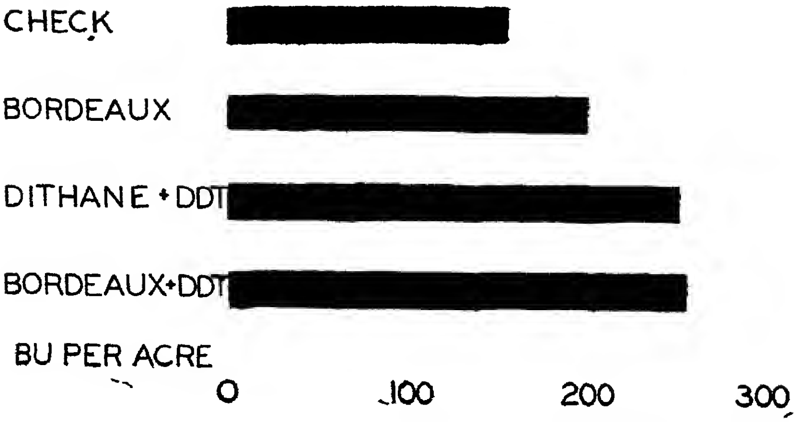
One of the new commercial fungicides which has shown promise in West Virginia is Dithane This material combined with DDT was compared with Bordeaux mixture with and without DDT. Since Bordeaux has some insecticidal effect against leafhoppers and since the Dithane alone does not show insecticidal effect against leafhoppers, it was believed that a fairer test of the Dithane would be obtained by using it with DDT in all cases In 1945 at Reedsville, (altitude 1700 feet) the Dithane + DDT plots outyielded Bordeaux + DDT plots by 39 bushels per acre and Bordeaux plots by 58 bushels per acre, as shown in table 1. The check plot yielded about one-third as much as the plot

Table 1—*Reedsville* 1945.



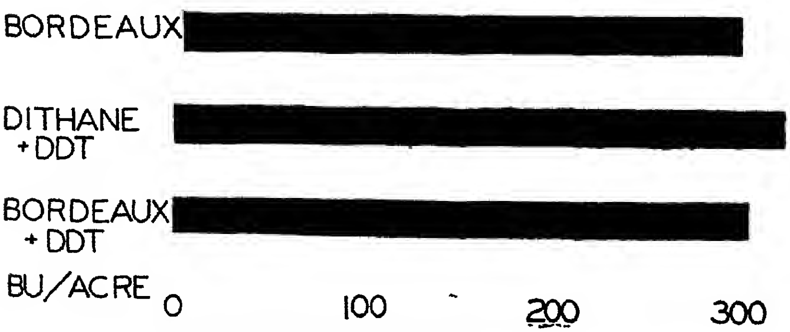
sprayed with Dithane + DDT In 1946, at Reedsville, the Bordeaux + DDT plots outyielded the Dithane + DDT plots by 4 bushels per acre, but the Dithane + DDT plots outyielded those receiving Bordeaux alone by 56 bushels per acre Late blight was present at Reedsville both years and was more severe in 1945 as noted in table 2. At

TABLE 2.—*Reedsville* 1946.



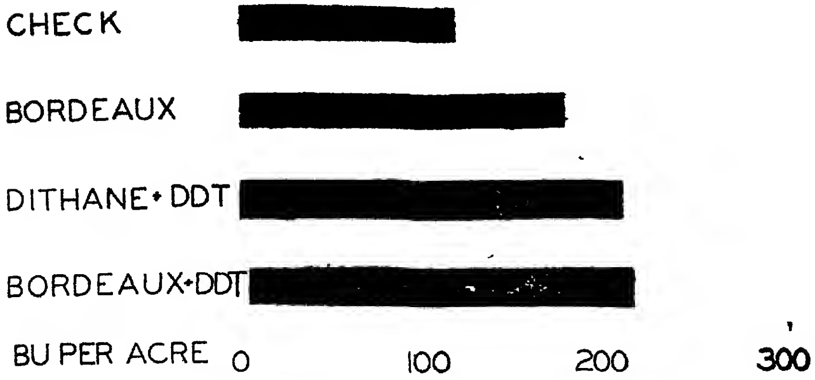
Graham Station (altitude 500 feet), in 1945, the Dithane + DDT plots outyielded the Bordeaux + DDT plots by 21 bushels per acre and outyielded those receiving Bordeaux alone by 26 bushels per acre as revealed in table 3. There was a considerable amount of early blight at Graham Station in 1946 but no late blight occurred. In 1946, at Huttonsville (altitude 2200 feet), plots receiving Bordeaux + DDT outyielded those receiving Dithane + DDT by only 4 bushels per acre, but Dithane + DDT plots outyielded Bordeaux alone by 34 bushels per acre. Late blight was present in epiphytotic proportions as shown in table 4.

TABLE 3.—*Graham Station* 1945.



These results indicated that under the conditions of these experiments, Dithane + DDT was as effective as Bordeaux mixture + DDT.

TABLE 4.—*Huttonsville* 1946



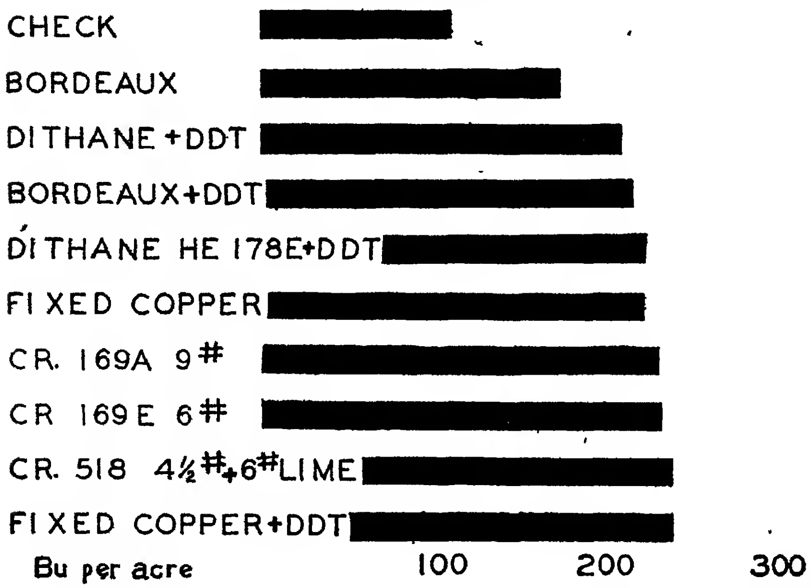
In 1946 at Huttonsville, Dithane + DDT was used on 50 acres of a 90-acre commercial potato field, the remaining 40 acres being sprayed with Bordeaux + DDT. Late blight appeared in the Dithane-sprayed portion of the field about 7 days before it appeared in the Bordeaux-sprayed portion and spread rapidly. In the Bordeaux-sprayed section blight appeared throughout the field but its development was checked In the Dithane section the blight continued to spread and all plants were killed from 12 to 20 days before they were dead or mature in the Bordeaux section. Yields in the Bordeaux section were greater than those in the Dithane section, although exact figures are not available

The failure of Dithane + DDT to give the expected control in a large commercial field was surprising However, the growing conditions at Huttonsville in 1946 offer a possible explanation of the failure In the first place, there was a continued wet, rainy period which lasted from the middle of June to the middle of August, which probably gave Bordeaux with its better sticking power and greater insolubility, an advantage over the Dithane + DDT In the second place, there was an unusually heavy epiphytotic of late blight which coincided with the wet and rainy period, starting unusually early and becoming very severe throughout the mountain valley in which Huttonsville is located This gave the spray material a more severe test than in previous experiments in West Virginia. In the third place, plots in this experiment were surrounded on all sides by other plots most of which had been sprayed with materials which give some protection against late blight. In such a layout it is probable that no one plot so surrounded gets as severe an infestation as it would in a large field

The spraying at Huttonsville was done with an 8-row power

sprayer,—carrying about 400 pounds pressure and applying about 125 gallons to the acre The manufacturers of Dithane have since informed us that they recommend using much lower pressures and driving through fields at slower speeds than normally used,—a practice which they claim is more suited to the peculiar properties of Dithane.

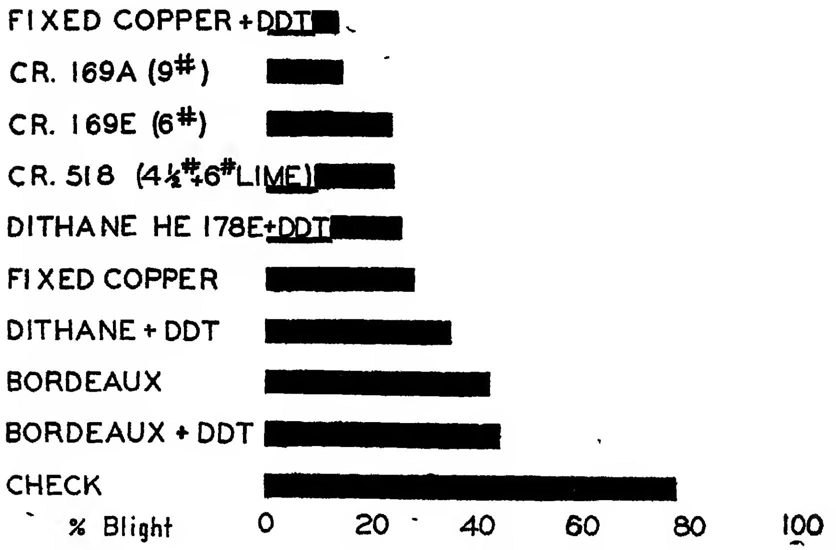
TABLE 5.—*Huttonsville* 1946.



In a test of 12 different fungicides in various combinations with and without insecticides, tribasic copper sulfate and certain exploratory chromate compounds gave the best results as shown in table 5. The fixed copper with DDT and Chromate 518 with lime gave the best yields with Chromates 169E and 169A close behind The reaction product of Dithane and zinc sulfate gave better results than the Dithane All of the treatments shown here gave yields significantly better than the check, but none of the treatments resulted in yields significantly greater than Bordeaux + DDT.

During July 1946, at Huttonsville, blight readings were taken and the data are recorded in table 6 These are an average of the readings of four observers on the entire replicated experiment The ratings of the treatments by the percentage of blight in general follow the ratings according to the yield In the blight ratings, however, there are statistically significant differences between Bordeaux + DDT and the

TABLE 6.—*Late blight—July* 1946, *Huttonsville*



following treatments: Fixed Copper + DDT, Chromates 169E, 169A, 518, and Dithane HE 178 E + DDT.

DISCUSSION AND CONCLUSIONS

At Reedsville, in 1945, late blight started late in the season but was quite severe. In 1946 it again started late but never became severe. At Huttonsville in 1946 blight started early and was very severe Dithane gave good protection against a mild attack of late blight and resulted in good yields at Reedsville in 1945 and 1946 in experimental plots and also in a larger field in 1946 At Huttonsville in 1946 it gave good results in experimental plots but was inferior to Bordeaux in a large commercial planting. This would indicate that Dithane is not adapted to the same conditions as Bordeaux in West Virginia, although it shows promise as a convenient protectant in some areas. It would probably be more acceptable in the form of the reaction product Dithane HE 178 E which gave better yields than Dithane and better protection in experimental plots and was also easier to handle and use.

The fixed copper (tribasic copper sulfate) with DDT and one of the exploratory chromates gave best results in the 1946 tests with 12 different materials. The chromate compounds, in addition to their fungicidal properties, on the basis of one year's results show some in-

secticidal properties against leafhoppers. The leafhopper population at Huttonsville in 1946, however, was light, and the materials should be tested under heavy infestations of leafhoppers to ascertain the extent of their insecticidal properties.

Summary

1 In comparison with Bordeaux mixture plus DDT, in experimental plots in 4 tests in three different localities, Dithane plus DDT gave as good results in yield and protection against late blight

2. *In a large commercial planting in one year (1946)* Dithane + DDT was inferior to Bordeaux + DDT in both blight protection and resulting yields.

3 Due to variation in climatic conditions, spray materials vary in their effectiveness in different localities in West Virginia.

4 The fixed copper (tribasic copper sulfate) and an exploratory chromate compound gave best protection and best yield results in a test of 12 different materials in 1946 in one locality

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THE INFLUENCE OF FERTILIZERS ON YIELD AND SPECIFIC GRAVITY OF POTATOES GROWN IN ALASKA

Zola M Fineman*

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In Alaska, high yields of potatoes are obtained only with the application of commercial fertilizers which supply the nutrient elements, nitrogen, phosphorus and potassium. The yield and cooking quality of potatoes grown in the Matanuska Valley are not so high as might be expected under the favorable climatic and soil conditions which prevail. Potato fertilizer recommendations for Alaska, in general, and the Matanuska Valley, in particular, are based on preliminary studies (1) (2). The recommended rates of nitrogen, phosphorus and potassium are based to some extent on the length of the growing season, type of soil, and the level of fertility maintained from year to year by crop rotation practices. Marked variations in cooking quality occur and attempts to associate them with environmental conditions and fertilizer practices are made. Recent studies have shown that fairly good estimates of

*Research Agronomist.

cooking quality from specific gravity readings are possible. To obtain information on the effect of different rates of nitrogen, phosphorus and potassium fertilizers on the yield and specific gravity of potatoes, the following study was made in 1945 at the University of Alaska Agricultural Experiment Station at Palmer, in the Matanuska Valley.

Materials and Methods

The soil of the field in which the test plots were planted is classified as a Knik Sandy Loam, is of loessial origin, and has been cropped for twenty-five years. The plots were planted with the most commonly grown local variety of potato, Arctic Seedling (apparently a type or strain of Green Mountain).

Nitrogen, phosphorus and potassium were supplied in the form of the commercial fertilizers, ammonium nitrate, superphosphate, and potassium chloride. These fertilizers contained approximately 30.0, 42.5 and 60.0 per cent respectively of nitrogen, phosphorus and potassium. The fertilizer treatments tested consisted of 27 possible combinations of 3 rates of nitrogen, phosphorus and potassium. Nitrogen was tested at the rates of 15, 30, and 45 pounds per acre. Phosphorus and potassium were tested at the rates of 30, 45 and 60 pounds per acre. The fertilizer was spread in the open furrow by hand and worked in with a wheel hoe. The plots were 1/300 of an acre (3½x41½ feet) in size. The seed pieces weighing approximately 1½ ounces were planted 18 inches apart. The plots were planted on the 21st of May and harvested on the 20th of September after the vines were killed by frost on the 6th of September.

The experiment was replicated four times and planted in randomized blocks. In addition to the 27 fertilizer treatment plots, each block contained 3 check plots (no fertilizer treatment).

Specific gravity readings were obtained by weighing at 25-30 pound sample of potatoes from each plot in air and in water, calculating the specific gravity from the formula:

$$\text{Specific gravity} = \frac{\text{Weight in air}}{\text{Weight in air} - \text{Weight in water.}}$$

Statistical analyses of the data were made by the analysis of variance method.

Yields

The mean yields of potatoes in bushels per acre of the 27 fertilizer treatments are given in table 1. A statistical analysis of these yields is

TABLE 1.—*Yields of potatoes grown with 27 rates of N-P-K fertilisers.*

Yields of Potatoes in Bushels per Acre Grown with the Indicated Pounds of N-P-K.

	Phosphorus 30 Lbs			Phosphorus 45 Lbs			Phosphorus 60 Lbs		
	Potassium			Potassium			Potassium		
	30 Lbs	45 Lbs	60 Lbs	30 Lbs	45 Lbs	60 Lbs	30 Lbs	45 Lbs	60 Lbs
Nitrogen 15 lbs.	322	359	363	336	328	352	351	335	370*
30 lbs	305	348	337	335	421	402	386	383	389
45 lbs	319	374	349	416	351	466	371	466	423

*For the 5 per cent level of significance, a difference of 28 bushels is required.

presented in table 2. The average yields for the three rates of nitrogen, phosphorus and potassium are shown in table 3

TABLE 2—*Analysis of variances of yields of potatoes grown with different rates of nitrogen, phosphorus and potassium fertilizers*

Source of Variation	Degrees of Freedom	Mean Square
N	2	14098*
P	2	18289*
K	2	8350*
N x P	4	5464*
N x K	4	1282*
P x K	4	1375*
N x P x K	8	17968*
Blocks	3	18200*
Error	78	386

*Significant difference

As shown in table 3, there were significant increases in yield with an increase in the rate of each fertilizer with the exception of the highest rate of potassium. Plots receiving 60K gave a slightly higher yield but not significantly so, than plots receiving 45K. Significant interactions for yield were obtained between the various rates of N, P and K. In general, these interactions resulted in an increase in yield with an increase in the rate of each element in the fertilizer This is also indicated by the rather consistent increases in yield from top to bottom and from left to right in table 1. Some deviations may be noted, particularly among plots receiving 45N.

TABLE 3.—*Mean yields of potatoes in bushels per acre grown with three rates of nitrogen, phosphorus and potassium fertilizers*

Rate	N	P	K
1	346	342	349
2	367	372	374
3	386	386	377

For the 5 per cent of significance, a difference of 9 bushels is required

The average yield of the 27 fertilizer treatments of 366 bushels was considerably greater than the average yield, of 211 bushels, of the check plots (not included in the tables). These results indicate that there were marked responses to the nitrogen, phosphorus and potassium fertilizers.

TABLE 4.—*Specific gravities of potatoes grown with 27 rates of N-P-K fertilizers.*

Specific Gravities of Potatoes Grown with the Indicated Pounds of N-P-K Fertilizers per Acre

		Phosphorus 30 Lbs			Phosphorus 45 Lbs			Phosphorus 60 Lbs.		
			Potassium			Potassium			Potassium	
		30 Lbs	45 Lbs.	60 Lbs.	30 Lbs	45 Lbs	60 Lbs.	30 Lbs.	45 Lbs	60 Lbs
Nitrogen	15 lbs.	1 0742	1 0740	1 0745	1 0761	1.0800	1 0733	1 0821	1 0781	1 0778*
	30 lbs	1 0753	1 0757	1 0706	1 0780	1 0755	1 0756	1 0772	1 0771	1 0731
	45 lbs	1 0728	1 0714	1 0697	1 0753	1 0713	1 0738	1 0731	1 0772	1 0713

*For the 5 per cent level of significance, a difference of 0018 is required

Specific Gravity

The specific gravities of the potatoes grown with the 27 fertilizer treatments are given in table 4. A statistical analysis of these specific gravities is presented in table 5 The analysis in table 5 indicates that there were significant differences in specific gravity of potatoes receiving the various rates of N, P and K. The mean specific gravities of the three rates of N, P, and K are given in table 6 and show that with each increase in the rate of N and K there was a decrease in specific gravity and that with each increase in the rate of P there was an increase in the specific gravity The data in table 5 indicate that there were no significant interactions between the different rates of N and P, N and K, and P and K Likewise, there were no significant interactions between the various rates of N, P and K.

Although there were no significant interactions between the different rates of N, P and K, various combinations of the different rates had an additive effect on the specific gravities. This is indicated by the data in table 4. It will be noted that the potatoes with the highest specific gravity (1.0821) were produced with the 15N-60P-30K fertilizer which had the lowest rate of N and K and the highest rate of

TABLE 5.—*Analysis of variances of specific gravities of potatoes grown with different rates of nitrogen, phosphorus and potassium fertilizers.*

Source of Variation	Degrees of Freedom	Mean Square
N	2	13174*
P	2	10014*
K	2	8015*
N x P	4	1311
N x K	4	236
P x K	4	386
N x P x K	8	2571
Blocks	3	33496*
Errors	78	1185

*Significant difference

P. The potatoes with the lowest specific gravity (1.0697) were obtained with the 45N-30P-60K fertilizer having the highest rate of N and K and lowest rate of P. These results might be expected on the basis of the individual effects of the different rates of N, P and K

Dunn and Nylund (3) give a comprehensive review to date of the results of studies on the effect of N, P and K fertilizers on specific gravity of potatoes. The results with nitrogen fertilizers are variable.

TABLE 6.—*Mean specific gravities of potatoes grown with three rates of nitrogen, phosphorus and potassium fertilizers.*

Rate	Nitrogen	Phosphorus	Potassium
1	1.0767	1.0731	1.0760
2	1.0753	1.0754	1.0756
3	1.0729	1.0764	1.0733

For the 5 per cent level of significance a difference of .0006 is required.

Depending on the soil and climatic conditions, nitrogen fertilizers raised, lowered or had no effect on the specific gravity. Under the soil and climatic conditions of this study, there was a marked reduction in specific gravity with an increase in the rate of N. In general, phosphate fertilizers increase specific gravity. Potassium fertilizers, particularly those containing chlorides lower the specific gravity. The results of Dunn and Nylund (3) and Smith and Nash (4) indicate that it is the chloride anion in the potassium fertilizers which is responsible for the lowering of the specific gravity.

The increase in yield and decrease in specific gravity with an increase in the rate of N and K indicates a negative relation between yield and specific gravity for the rates of N and K tested. A possible explanation of this relationship may be the effect of N and K on tuber growth and storage. Data were obtained on the number and size of the tubers per plant with the different fertilizer treatments. There was very little difference in tuber number between fertilizer treatments. There were, however, marked differences in tuber size which were highly associated with differences in yield. Tuber size increased with each increase in rate of N, P and K.

The increase in tuber size with an increase in the rate of N and K was accompanied by a decrease in specific gravity. The decrease in specific gravity due to the potassium fertilizer has been explained by the adverse effect of the chloride anion. The reduction in specific gravity with higher rates of N may be due to the increased plant and tuber growth at the expense of starch storage.

Dunn and Nylund (3) and Scheele, Svensson and Rasmusson (5) found a very high correlation between specific gravity and dry matter. With the aid of the proper graph or regression equation, the dry matter content may be calculated from the specific gravity. Using the regression equation supplied by Dunn and Nylund (3) the dry matter content of the potatoes grown with different rates of N-P-K fertilizers was calculated. A dry matter content of 21.82 per cent was obtained for

the potatoes having the highest specific gravity (1.0821) and grown with the 15N-60P-30K fertilizer. A dry matter content of 18.42 per cent was calculated for the potatoes with the lowest specific gravity (1.0697) and grown with the 45N-30P-60K fertilizer. The first figure (21.82) represents an increase of 18.48 per cent in dry matter over the latter figure (18.42).

Summary

The yield and specific gravity readings were obtained for potatoes grown with 27 fertilizer treatments having different rates of nitrogen, phosphorus and potassium. The 27 treatments consisted of all possible combinations of three rates of nitrogen, phosphorus and potassium. Nitrogen was tested at the rates of 15, 30 and 45 pounds per acre. Phosphorus and potassium were tested at the rates of 30, 45 and 60 pounds per acre.

An increase in yield was obtained with each increase in the rate of nitrogen, phosphorus and potassium.

A decrease in specific gravity was obtained with each increase in the rate of nitrogen and potassium. The decrease in specific gravity with the potassium was attributed to the chloride anion.

An increase in specific gravity was obtained with each increase in the rate of phosphorus.

Marked differences in specific gravity were obtained between fertilizers having different rates of nitrogen, phosphorus and potassium.

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SECTIONAL NOTES

ALABAMA

The Alabama Commercial potato crop was planted between the 25th of January and the 15th of February Baldwin County planted a total of 254 cars of seed—450 bags each Figuring between 50 and 55 acres per car of seed, an estimated 13,000 acres have been planted. Other counties in the commercial area of Alabama have planted nearly 4,000 acres This total planting is more than seemed likely a few weeks ago The alleged frost damage to some of the Florida crop gave our growers, some of them, more gambling spirit. Most of the plantings are under the amount allotted to the grower for support price from the government.

The weather has been a factor in Alabama this year December and early January were damp and warm almost like spring. The month of February is reported to have been the coldest in half a century Although about 21 above zero was the lowest temperature, we have had several days with ice. Had it not been for this continued cold period during February, the potatoes would have emerged and been cut back by the temperature of 26 above which occurred on the 3rd of March. A survey indicated that very little damage was done because most of the sprouts are still an inch or more below the ground surface. The delay in emergence, by light of past experience, does not indicate that our crop will be much later than usual. The potatoes have a way of catching up and will be ready for harvest operations in approximately 90 days from the time of planting.

Plans are being made by the growers to either spray or dust their crop for control of Late Blight Dithane will be used for spraying almost 100 per cent In general Copper-hydro, Cuprocide, and C-O-C-S will be the dusts used. Dithane Z78 dust will be used on several plots, and DDT will replace arsenic for the control of the colorado potato beetles.

One hundred and eighty samples representing as many sources of seed were planted at the Gulf Coast Substation, Fairhope, Alabama. Besides this, nearly 20,000 seed pieces representing that many tubers have been planted for index readings. Another technical dust and spray experiment will be conducted to compare the value of leading spray and dust products. (Mar. 5) —FRANK E. GARRETT.

CALIFORNIA

It now appears that the potato acreage will be some where between

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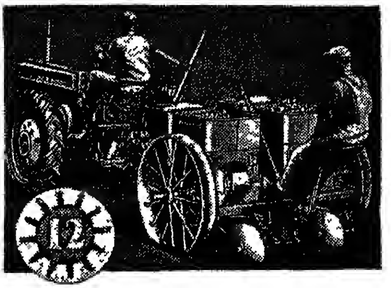

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45,000 and 50,000 No survey has yet been completed. This will be approximately 15,000 acres less to harvest in 1947 than were harvested in 1946.

Potato seed was plentiful this year. Many seed growers have had to dispose of their seed stock on the commercial market.

Potatoes in the early Edison District are now up to a good stand in many fields and growing rapidly. Harvesting will probably start about the middle of April. The exact date that harvest will begin will depend upon two factors, yield and price. If the price is high, the growers may start digging with a low yield. If the price is not very high, the growers will probably delay a start of harvest until a later date. (Mar 4).—M A. LINDSAY

IDAHO

The potato market has been very draggy, but many dealers feel that the supply of good quality table stock potatoes in Idaho is rapidly reaching the end that within two or three weeks some communities will be pretty well cleaned up. Within six weeks most of the good table stock will be shipped They anticipate considerable less stock shipped and a much earlier clean-up than last season. The diversion program has had a big influence on the supply as has also, in general, the poorer keeping quality of the crop this year.

Readings from the winter tests from the seed potato plots are practically complete and indications are that not more than one-third as many lots will be rejected as ineligible for re-certification as compared with last year. This emphasizes the value of the winter test plots in reducing virus disease in the certified seed lots. It also refers particularly to mosaic since leafroll has not as yet appeared in the principal certified seed-producing areas of the state.

Indications point toward a larger percentage of the commercial acreage to be planted with certified seed and the general abandonment of the growing of seed plots for "one year out of certified seed" in the Boise Valley area where leafroll has been a factor in the commercial potatoes. Seed surplus seems to be ample but supplies are not nearly so large as production figures would indicate, first, because a considerable part of the seed being sorted out and sold as bakers for table stock; and secondly, to the frost injury in the fall which prevented harvest of approximately 5 per cent of the certified seed acreage and lowered the keeping quality of much that was harvested.

Growers indicate a considerable shift to sugar beets and beans, par-

ticularly in southwestern and south central Idaho, with a corresponding reduction in potato acreage for 1947. (Mar. 4)—John R. Robertson.

Indiana

All is rather quiet on the potato front here in Indiana, except the seed situation There is going to be quite a scramble for good certified seed this year and particularly by our small growers for both Sequoia and Sebago seed. It seems as if there is going to be a considerable shortage of those two varieties this year in our state The results of many demonstrations in the state have been so gratifying that the newer varieties are replacing the older strains. The Irish Cobbler and the Katahdin will also have a place on the mineral and upland soils and a few will continue to plant those varieties.

The acreage in Indiana this year will be above normal and practically all of it will go for local consumption. (Mar. 3)—W. B. Ward.

Maine

Maine and the potato industry, in general, have been getting some very unfavorable comments largely because of the disposal program for surplus spuds. Unjustly, Maine believe about 90 per cent of Arroostook farmers took loans which assured them price support Maine has exported approximately 3 million bushels and expects to export an additional 5 million. The industry has long advocated the export of surplus potatoes, but not until ex-President Hoover made his recent report on the food situation in Europe has there been much action.

Aroostook has dumped approximately 3 million bushels of potatoes, which were under special loan and approximately 7½ million bushels of the regular loan potatoes. All of these potatoes were deteriorating or were endangering other potatoes About 6 million bushels have gone into starch and alcohol, with possibly an additional 3 million. The dumping program ended the 5th of March with export business opening in volume. The export deal is largely responsible for the market going slightly above support prices for the first time in the marketing season.

It is expected that farmers will receive their potato allotments by the 15th of March. Aroostook received 166,000 of the 186,000 acre State allotment. Farmers are accepting the fact that acreage allotment must be a part of the price support program and will go along with the program.

Maine has more good seed potatoes than ever before in its history The Florida test showed that seed plot methods and DDT resulted in the production of excellent seed. For instance, 59 per cent of all Chippewas

read less than 2 per cent in Florida The figures for the 1945 crop were 22 per cent less then 2 per cent Seed is moving slowly at present (Mar. 6) —VERNE C BEVERLY.

NEBRASKA

The most hectic potato season in years is almost completed Much of the low grade stock is being dumped, in line with Government support program. Most of the better quality stock has been shipped at this time Certified shipments are still continuing, but at a decreased rate Very little Blue Tag Certified is left in the country at this time.

As was anticipated earlier, considerable grading difficulties arose Since most of our acreage consists of the Triumph variety, which is very susceptible to cracking at harvest time, many growers had trouble making U S No. 1 Grade In most sections of the state, when a tuber defect was severe enough to throw out of U. S. No. 1 Grade, it was also too severe for U. S. No 2

The high sort-out percentage, and the high price of labor for the crop has done much to cause discussions on acreage for 1947. Most growers feel that they will cut acreage considerably Others feel that since all the neighbors are going to cut acreage, that they will increase theirs, so at the present time, it is hard to make a prediction on acreage for certification this year. The over-all picture will probably see a reduction, both on certified acreage and the commercial acreage

Moisture conditions on dry land are not ideal. Much of the moisture for this type of farming comes with winter snows. The snows have not been present this season. Unless more moisture is received in the next few months and a wet summer is experienced, the yield on dry land potatoes for this coming year is liable to be small

Growers' meetings have been held throughout the territory by the Extension Department of the University These meetings have been very poorly attended, which further substantiates the lack of interest on the part of growers with regard to potatoes at this time. (Mar. 3).—J J SHAUGHNESSY.

NEW YORK

The local demand for potatoes is very strong and prices are at the basis of support which is $2 40 cwt The local demand is accentuated by the shortage of cars in other sections which has added temporarily to reduced imports The present weather conditions will still further curtail supplies and after another day or so there will be a big demand for potatoes that are accessible to nearby markets

Seed potatoes are beginning to be in demand now that acreage allotments and more or less of a government program has been announced for 1947. Up state New York was cut about 10 per cent and Long Island about 20 per cent. The demand is greater this year than in past seasons for Katahdins

Potato growers generally are appreciative of the condition the potato industry is in and will have some system of marketing which will keep the better grades going to market and the poorer grades at home There is a strong sentiment for marketing agreements or something of that nature. It is a well known fact that unless some means is provided for utilizing low grades and off sizes that they will eventually find a market, so it has been suggested in several instances that government support may be utilized to establish facilities for making starch, potato flour, etc. The thought is that these funds could be amortized over a long period to a person or group of persons and the ultimate effect would be very beneficial to the industry as a whole (Mar 4) —H J Evans.

Pennsylvania

Certified seed potatoes are being removed from storage in better shape than was expected when they were placed in storage last fall Although there is some rot, it is not so serious as was expected. Because of the large crop, the tubers are rougher and there are more over-sized tubers than usual. The percentage of grade-outs is running quite high

The demand for seed is very poor A number of table stock growers have expressed intentions of cutting their acreage during 1947 There is some feeling that the price prospects for 1947 are somewhat discouraging because of the continued scarcity and high cost of labor, machinery and other items that go into the production of a crop of potatoes (Mar. 3.)—K. W. Lauer.

South Carolina

The acreage allotment for South Carolina early potatoes is only slightly less than that of last year. Most growers have tried to stay within their allotments, hence we expect a 6-8 per cent decrease in total acreage

Planting began from three to five days earlier than usual because of excellent weather conditions Almost one-half of the crop was planted before the freezing began on the 5th of February. All plantings were completed by the end of the third week in February. Part of the late plantings went into rather dry soil and some dry rot may be evident. One-half inch of rain fell on the 1st of March and the soil is now in good con-

dition The earliest plantings have sprouts ½ inch long, hence will probably not emerge before the 20th of March even though temperatures return to normal Our area is below normal in rainfall which should assure good stands The variety picture has been changed only slightly this year. Sebago acreage has increased while Pontiac decreased somewhat. Estimated plantings in Charleston County which contain about one-half the total state acreage were obtained by tabulating seed sold by local brokers They are as follows: Bliss Triumph 1 per cent, Pontiac, 11; Cobbler, 38, Katahdin, 32; Sebago, 16, and White Rose 2 per cent. The state average would probably run as follows, Bliss Triumph, 5 per cent; Pontiac, 10; Cobbler. 40; Katahdin, 30; Sebago, 14; and White Rose 1 per cent.

Charleston County growers and shippers are investing $250.000 in washing, grading and drying equipment for the approaching season It is thought that this will be adequate to handle about one-half the potatoes in this county.

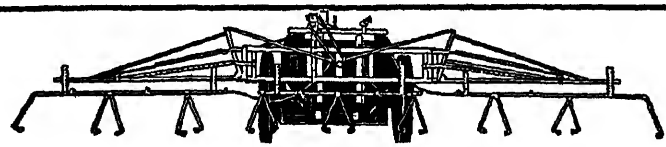
The railroads are attempting to take away our shippers privilege of refrigeration in transit. A hearing before the I.C C. will be held on the 9th of April. If the refrigeration privilege is withdrawn, our washing program will receive a real blow as washed new potatoes need refrigeration to prevent soft rot in transit (Mar 5) —W. C Barnes

Vermont

Indications point to approximately the same acreage planting in Vermont this spring as for 1946 Latest revised estimate for this was somewhat over 8000.

Owing to the slight premium available for certified seed compared with table stock and stable stock, to apply the most obvious term to government purchased stock, much of the 1946 certified seed crop in Vermont has been allocated for non-seed use. The difference between the cost of used bags in which the commercial pack could be moved, and new bags required for seed, usually more than off-set the small premium offered.

Starting in a small way to build up safe foundation stock, a basic plot of one acre was grown under supervision of the State Department of Agriculture and the Agricultural Experiment Station by W A Willard of Derby. The plot was all tuber-unitted. carefully rogued and was early harvested about the 10th of August by top pulling A sample in Florida showed 0 3 per cent leafroll and no other disease. the variety of which was Green Mountain It is hoped that the crop of approximately 200 bushels will be increased this year by growers operating



HARDIE SPRAYERS
1947

under new foundation stock rules set up by the Department. This basic crop plan was financed by the so-called Merck fund, $500 provided by George W. Merck of Rupert, Vermont, and New York.

The potato session in the Union Agricultural Meetings held in Barre, from the 11th to the 14th of February was particularly well attended. Guest speakers were Ford S. Prince of New Hampshire University and Dr. R. J. Haskell of the U. S. Extension Service, Washington, D. C. The selection of varieties, ring rot and leafroll control were chief topics of discussion. (Mar. 6).—HAROLD L. BAILEY.

WASHINGTON

The Washington winter test plots at Oceanside, California, were read from the 23rd to the 26th of February. The results of the readings give our growers many indications that they have overcome the serious disease problems which they encountered during 1944 and 1945.

In the case of our White Rose 46 per cent of the fields certified in the State of Washington showed less than one per cent total virus, and eighty-five per cent showed less than 4 per cent total virus.

In the case of our Gems where the leafroll problem was being considered hopeless by many during 1944 and 1945, 49 per cent of the certified Gems contained less than one per cent total virus and eighty-eight per cent contained less than 4 per cent.

Since we still had a few blow-ups it might indicate that conditions necessary for such were present. It might further indicate that the great improvement over previous years was made primarily because of the adoption of new practices. In checking back on the seed stocks used last year we found that the blow-ups referred to were in fields which were planted with seed stock containing a higher proportion of total virus. We found no case where it was impossible to ascertain the reason for the resulting excessive amount of virous disease.

We feel the major reasons for the great improvement this last year were: first, planting of much cleaner seed stocks; secondly, more thorough roguing; thirdly, the use of DDT dust to control the aphid population, and fourth, early killing of vines with various chemicals.

All indications point towards a reduction in our seed acreage for the coming year. (Mar. 6) —HAROLD S. SCHAAD.

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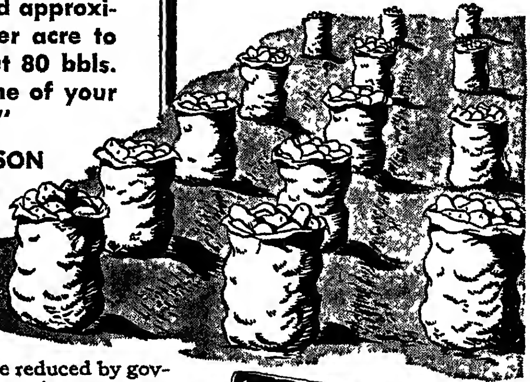

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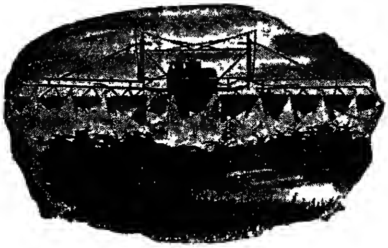

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NEW BRUNSWICK, N J.

ORGANIC FUNGICIDES FOR LATE BLIGHT IN CONNECTICUT

JAMES G. HORSFALL AND NEELY TURNER[1]

Connecticut Agricultural Experiment Station, New Haven, Conn.

The importance of organic pesticides on potatoes waxes as the importance of Bordeaux mixture wanes. At present disodium ethylene bisdithiocarbamate and its more stable relative zinc ethylene bisdithiocarbamate are coming into the field as fungicides for late blight.

Disodium ethylene bisdithiocarbamate (hereafter called by its nickname "Dithane" for short) has been studied on potatoes almost ever since its babyhood here in 1941 (2). It was evident early that the material had insufficient insecticidal qualities to compete with Bordeaux mixture on Connecticut Valley potatoes It soon made a place for itself, however, (6) on late blight in Florida, where the insecticidal action of Bordeaux is at a minimum.

Heuberger and Mann's discovery (3) of the salutary influence of zinc sulfate and lime on disodium ethylene bisdithiocarbamate elevated it from the level of mediocrity into a promising material for late blight. This did not provide insecticidal qualities, and hence, the material still had no place in the Connecticut Valley, but with the advent of DDT in 1944 to control insects, its fungicidal role began to show in true perspective This paper will serve to record experiments with it and other fungicides on potatoes in 1944, 1945 and 1946.

[1]The authors wish to thank R W Barratt, Arthur Kelman, and A. D. McDonnell for much assistance in the field work.

Materials and Methods

Two types of methods were used in the work—intensive and extensive. The intensive work was done on the Station farm at Mt. Carmel, Connecticut Plots in 1944 and 1945 were single rows 10 feet long, randomized in four blocks. The sprayer was a typical three-nozzle to the row arrangement mounted on bicycle wheels. Specifications for application were 200 pounds pressure, 3/64 inch orfices, 200 gallons per acre. There were four doses of each pesticide with a dose ratio of two. The technique in 1946 differed only in that the plots were of three rows, 23 feet long and the dose ratio for the pesticides was three. Data were taken from the center row only. With the exception of 1946, the data given are the means of all four doses and the four replicates of each, making sixteen determinations for each reading.

Insect damage and late blight reading were based on the grading scale described by Horsfall and Barratt (4).

The extensive work was done on farmers' farms, with their equipment and labor in 1945 and with our commercial equipment and labor in 1946

Results in 1944

Two experiments were performed at Mt. Carmel in the severe drought year of 1944, one on Cobblers in which only flea beetles were involved, and one on Green Mountains where both flea beetles and leafhoppers were involved No late blight occurred in either plot.

Data are given in table 1. The data show that Dithane either alone or plus zinc sulfate and lime is almost without effect on leafhoppers or flea beetles. Its chemical relative, tetramethylthiuram disulfide (Thiosan, now Tersan), was somewhat better, but far inferior to DDT. The deduction is obvious. However, good dithiocarbamates might be for the control of late blight, they could never succeed alone in the Connecticut area where flea beetles and leafhoppers are usually serious.

1945 Results

In 1945 another test was run on late-planted Katahdins (June 1) using Bordeaux, Dithane plus zinc sulfate and lime all season, DDT spray all season, and DDT spray all season plus Dithane plus zinc sulfate and lime beginning on the 30th of July shortly after the onset of blight. The season was abnormally wet so that blight developed heavily, but leafhoppers and flea beetles were not very serious. This was the opposite of 1944. Data are given in table 2.

TABLE 1.—*Effect of two dithiocarbamates, DDT and Bordeaux on potatoes in a blight-free year.*

Treatment	Green Mountain					Cobblers		
	Per cent Tip Burn		No. Leafhoppers per Leaflet		Yield, Bu. per Acre	Per cent Flea Beetle Damage	Per cent Dead Foliage	Yield, Bu. per Acre
	Aug. 4	Aug. 13	July 18	Aug. 2		June 5	July 11	
DDT dust[1]	22.4	74.0	8.0	9.3	140	8.4	16.9	163
Dithane[2] alone	43.9	88.0	36.8	44.5	118	18.5	39.4	131
Dithane[2] + $ZnSO_4$ + lime	42.4	85.8	30.0	31.5	134			
T M T D[2]	31.5	80.8	30.5	29.8	137	12.9	21.7	146
Bordeaux mixture[3]	35.1	82.4	37.5	39.2	128	13.1	26.6	134
No treatment	49.8	82.4	35	38	132	19.0	34.5	144

[1]Results are the means of four dosages 4, 2, 1 and 0.5 per cent active ingredient in dust.

[2]Results are the means of four dosages 4, 2, 1, 0.5 lbs. of active ingredient per 100 gallons. Zn SO_4 used at corresponding ½ rate and lime at ¼ rate.

[3]Results are the means of four dosages 2, 1, 0.5 and 0.25 lbs. of active ingredient per 100 gals. Lime used at corresponding ½ rate.

Since the season was opposite to 1944 the results were opposite. Dithane outyielded DDT as much or more in a wet season with few insects as DDT outyielded Dithane in a dry season with no disease It is obvious that each organic must supplement the other in a complete potato spray. Since forthcoming events are said to cast their shadows before, it is noteworthy that Dithane outyielded Bordeaux even though it produced no better disease control.

Several farmers in the Valley compared Dithane with Bordeaux during the blight epidemic of 1945. The yields from large unreplicated plots on those farms where records were taken are given in table 3. Where records were taken, DDT was used for insect control.

TABLE 2.—*Effect of Dithane plus Zinc sulfate and lime with and without DDT, Bordeaux and DDT on potatoes in a blight year.*

Treatment	Per cent Leaf Area Blighted	Yield, Bushels per Acre
DDT all season[1]	61	171
DDT all season[1] Dithane[2] after July 30.	18	214
Dithane[2]	17	231
Bordeaux[3]	14 5	205
No treatment	71	132

[1]Results are the means of 4 dosages 1, 0 5, 0 25, and 0.125 lbs. per 100 gallons

[2]Results are the means of 4 dosages 4, 2, 1, 0.5 lbs. active ingredient per 100 gallons. Zn SO_4 at ½ rate Lime at ¼ rate

[3]Results are the means of 4 dosages 16, 8, 4, 2 lbs. active ingredient per 100 gallons. Lime at equal rate.

TABLE 3.—*Effect of Dithane plus DDT and Bordeaux plus DDT on commercial forms under late blight and insect conditions,* 1945.

Farmers	Variety	Yield in Bushel per Acre		
		Bordeaux	Dithane	Net Change
Daigle	Chippewa	290	290	0
Daigle	Katahdins	249	274	+25
Wetstone	Green Mountain	325	360	+35
Ellsworth	——	308	271	—37
Bahler	Green Mountain	414	452	+38

In general Dithane outyielded Bordeaux in the commercial fields as it did on the experimental plots.

Experience with farmers in 1945 showed one other significant fact. Farmers who used calcium arsenate as an insecticide with Dithane in 1945 seemed to obtain inferior blight control and lower yields than farmers who used DDT as an insecticide. This confirms laboratory research which shows that calcium arsenate reduces the stability of Dithane.

1946 Results

In the intensive project in 1946, the basic objective was to investigate the interactions between five fertilizer levels and four concentrations of Bordeaux and Dithane. For the purposes of this report the five fertilizers and four doses are pooled to give a mean based on 80 plots for each pesticide. There were two checks in each fertilizer, making 20 untreated plots

Late blight attacked about mid-August. Three readings for late blight were made on the 22d and 27th of August and the 10th of September. Yields were taken after the plots died down. Data are given in table 4.

Whatever else may come out of the complex experiment upon later analysis, it is quite clear again in 1946 as in 1945, that the Dithane and Bordeaux gave essentially equal disease control, but that Dithane outyielded the Bordeaux by approximately 20 per cent.

In 1946 some large scale potato spraying tests were made on commercial farms. The plots were 10 rows wide, and about 700 feet long (approximately ½ acre each) in two randomized blocks. They were sprayed at 400 pounds pressure with commercial equipment using four nozzles (3/64"D) per row. Weekly applications from the 1st of July to the 7th of September were made using Dithane plus zinc sulfate and lime, zinc ethylene bisdithiocarbamate, 2,3-dichloronaphthoquinone (Phygon) and yellow cuprous oxide (Cuprocide). The first treatment was repeated on all five experimental farms, the second on four, the third on two, and the fourth and fifth on one each. One-half pound of active DDT was added to each 100 gallons of all sprays except where hexachlorocyclohexane was used. It was also used at a concentration of one-half pound of total chemical (not gamma isomer) per 100 gallons.

Late blight struck fairly heavily in the Valley as shown by the destruction in poorly sprayed fields. Little disease showed in the treated blocks. There was some Botrytis especially in the Bordeaux-sprayed blocks. There were distinctly more aphids in the Bordeaux-sprayed plots than on the others. The data are recorded in table 5. It

TABLE 4.—*Effect of dithane and bordeaux mixture each with DDT on flea beetles, leaf scorch, and late blight.* 1946.

Treatment	Dosage. Lbs. per 100 Gallons		Per cent of Foliage Area Blighted			Yield Bushel per Acre
	Fungicide	DDT	Aug. 22	Aug. 27	Sept. 10	
Bordeaux	18-9	2	Trace	Trace	2.30	310
	6-3	67	Trace	0 45	6.50	311
	2-1	22	0 50	0 80	35.50	270
	.67-33	07	4.34	6 80	92 40	176
Dithane	6	2	0	Trace	0 80	373
	2	.67	Trace	Trace	2 85	355
	67	.22	0 65	0 98	52 50	253
	22	.07	4.36	9 20	92 90	216
No Treatment	—	—	17.0	70 0	98 27	137

TABLE 5.—*Effect of dithane, bordeaux, zinc dithane, cuprocide, and phygon all with DDT under late blight and insect conditions,* 1946.

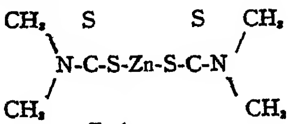
Farmers	Bordeaux Mixture	Lithane Plus Zn SO_4 Plus Lime	Zinc Dithane	Phygon	Cuprocide	Zinc Dithane Plus Hexachloro-cyclohexane
Grant	498	480	—	422[2]	—	—
Ellsworth	333	370	444	—	—	—
Clark	260	295	—	—	—	—
Cohen	490	505	—	—	425	—
Hutton[1]	444	—	520	—	—	470

[1]4 half-length replicates instead of two

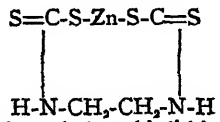
[2]only one replicate.

is clear again that the organic dithiocarbamate outyielded the Bordeaux in three of the four fields. The zinc salt outyielded both in the two fields tried.

One farmer independently compared the two zinc dithiocarbamates, zinc dimethyl dithiocarbamate (Zerlate) and zinc ethylene bisdithiocarbamate. The late blight attacked the former much earlier and was more severe than on the latter. Verbal reports say that the same situation obtains in other areas. This type of result is sufficient to demonstrate that the configuration of the molecule is of great importance in fungicidal and protective action. Both molecules contain one atom of zinc and both contain two dithiocarbamate radicals, but the performance on late blight is radically different. The two molecules are shown herewith:



Zerlate



zinc ethylene bisdithiocarbamate

It is worthy of note that zinc dithane contains a replaceable hydrogen in the secondary amine. Barratt and Horsfall (1) have suggested that the double bond to the sulfur can oscillate between the sulfur and the nitrogen and form the isomeric—SH compound which is probably more active than the original.

It seems very significant that disodium ethylene bisdithiocarbamate plus a small amount of zinc sulfate and lime should outyield Bordeaux mixture even though it does not control late blight any more effectively. This suggests the obvious conclusion that the Bordeaux is more injurious to the potatoes than the organic material (5). Research in several regions (5) has already indicated that the lime in Bordeaux contributes to its injuriousness. Although the dithiocarbamate spray contains some lime, it contains much less than the Bordeaux mixture.

In this connection it is further significant that the zinc salt, by the same reasoning, was less injurious than the sodium salt plus zinc sulfate and lime. The zinc salt contains no lime whatsoever.

Summary

This paper briefly reports three years research on new fungicides especially dithiocarbamates on potatoes in Connecticut. Dithane, first tested here in 1941, and reported in 1943 has long been under test for late blight of potatoes. It has succeeded in areas like Florida where flea beetles and leafhoppers are of minor consequence. Until the advent

of DDT to control these two pests, dithiocarbamates could not succeed elsewhere. The data reported herein suggest that dithiocarbamates, particularly Dithane, are not much if any better than Bordeaux mixture in the control of late blight, but they do permit the potatoes to set a larger yield.

It is suggested that this is due to a lower level of phytoxicity which, in turn, is due to low lime content of the Dithane.

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OBSERVATIONS ON THE USE OF POTATO VINE KILLERS IN THE RED RIVER VALLEY OF NORTH DAKOTA[1]

WM. G HOYMAN[2]

North Dakota Agricultural Experiment Station and State Seed Department, State College Station, Fargo, N. Dak.

The use of potato-vine killers in the Red River Valley of North Dakota is a recent practice and only a small percentage of the growers have used one or more of the products available for that purpose. A satisfactory killer is needed to advance the date of harvest in order that growers of certified seed may ship to southern states and Cuba for early-fall planting. In years when killing frosts occur late it would be desirable for most growers, and especially those with large acreages, to kill the vines in order that harvesting may proceed before the arrival of inclement weather. Although late blight, caused by *Phytophthora infestans,* has occurred occasionally since its first report on North Dakota potatoes in 1942, vine killers would be useful in preventing the spread of this pathogen and in reducing the amount of tuber rot reported (1) in tubers harvested from late-blight-infected vines. During years of excess moisture late in the

[1]Commercial companies cooperating in the work included the American Cyanamid Company, the Dow Chemical Company, F. H Peavey and Company, and Standard Agricultural Chemicals, Inc

[2]Associate Plant Pathologist, North Dakota Agricultural Experiment Station and State Seed Department.

season, vine killing would also be desirable in order to arrest tuber size and second growth.

In order to determine the effectiveness of some of the various products available for vine killing, experiments were conducted in growers' fields and at the North Dakota Agricultural Experiment Station and State Seed Department plots at Grafton, North Dakota, during the latter part of the growing season of 1946 The plots varied in size from 2 to 8 rows wide and 80 to 300 feet long. A power-take-off, Bean sprayer and tractor-mounted, Niagara duster were used for applying the materials. The former was fitted with nozzles that delivered a hollow-cone or fan-type spray pattern. Pressures of 400 and 200 pounds were maintained with the respective types and either gave satisfactory coverage. Since climatic conditions affect the action of herbicides, the official rainfall record at Grafton, from the 1st of May through the 25th of September 1946, is given in table 1.

TABLE 1.—*Rainfall record at Grafton, North Dakota, from May 1 through September 25, 1946.*

Day	Month				
	May	June	July	August	September
1					
2				04	
3	.18			.15	
4	17		.04		
5	.10				.02
6	01	.15	.04		
7		24	.55		
8					
9	.13			.14	
10			10		
11			08		
12					
13					
14	.43				
15				02	
16		.10			
17	.19	.03	.07	.78	07
18				02	2 54
19	08				1.29
20		02			
21				30	
22		13			57
23			.20		25
24		70			05
25					
26		97		1 53	
27				.23	
28		1.15			
29		24			
30					
31					

The first application was made on the 1st of August with Dowspray 66 Improved at 2 gals. per 100 gals. of water in a field of early-planted Red Warbas. The temperature was 83° F. the evening the spraying was done and the effectiveness, as indicated by the rapidity of kill in table 2, was rated at 4. Weed Killer A dust and spray, Micropulverized AERO Cyanamid dust and spray, Pulverized AERO Cyanamid dust, Sinox, 2 concentrations of Sinox General, ammonium dinitro butyl phenol, and Dowspray 66 Improved were applied to Bliss Triumph vines on the 15th of August when the temperature was 75 to 80° F. No dew was observed on the foliage at the time or 10 days following the application. The ratings in table 2 indicate the dusts were very ineffective. Weed Killer A at 50 lbs. per 100 gals. of water was the most rapid killer. The next applications included Weed Killer A spray, Micropulverized AERO Cyanamid spray, Dowspray 66 Improved with and without aluminum sulphate, ammonium dinitro butyl phenol, 3 concentrations of Sinox General, and Sinox. The treatments were made on the 19th of August in a field of Pontiacs that had an abundance of vine growth. During the applications the temperature ranged from 74 to 83° F. Weed Killer A at 37.5 lbs. per 100 gals. of water was very effective (rating of 1) and Dowspray 66 Improved with 2 lbs. of aluminum sulphate was given a rating of 2. Poorest of this group were Micropulverized AERO Cyanamid and 1½ pts of Sinox General with 1 gal of diesel oil.

Four concentrations of phosphoric acid, ammonium dinitro butyl phenol with ammonium sulphate, and Sinox General with and without ammonium sulphate were applied to Bliss Triumphs on the 4th of September. The temperature ranged from 68 to 72° F. The ratings indicate phosphoric acid killed slowly at the lowest concentrations and fairly rapid at the highest (10 gals.) concentration. Phosphoric acid was injurious to certain parts of the Bean sprayer and had to be handled with care. The effectiveness of ammonium dinitro butyl phenol and Sinox General was increased by the addition of ammonium sulphate. The final tests were made on the 6th of September with Weed Killer XA. It was used at 16, 33, and 50 lbs. per 100 gals. of water when the temperature was 55° F. The results indicate it was not as effective as Weed Killer A or some of the other materials.

An unexpected observation 2 days following the application of Dowspray 66 Improved on the 1st of August was the brown discoloration present within and adjacent to the vascular (conductive) tissue of a majority of the Red Warba tubers (Fig. 1, A). An examination of the vines disclosed the discoloration was also present in the petioles, stems, and stolons. Steinbauer (5) has reported a slight discoloration of the

TABLE 2.—*The effectiveness of various potato-vine killers.*

Vine Killer	Method of Application	Quantity per 100 Gals. Water	Quantity per Acre	Effectiveness[1]
Dowspray 66 Improved	Spray	1 gal.		5
Dowspray 66 Improved	Spray	2 gal		4
Dowspray 66 Improved	Spray	1 gal, 2 lb. aluminum sulphate		3
Dowspray 66 Improved	Spray	2 gal, 2 lb aluminum sulphate		2
Weed Killer A[2]	Spray	37.5 lb.		1
Weed Killer A[2]	Spray	50 lb		1
Weed Killer A[2]	Dust		100 lb	7
Micropulverized AERO Cyanamid	Dust		100 lb	7
Micropulverized AERO Cyanamid	Spray	66 lb		6
Pulverized AERO Cyanamid	Dust		60 lb	6
Weed Killer XA[2]	Spray	16 lb.		5
Weed Killer XA[2]	Spray	33 lb		4
Weed Killer XA[2]	Spray	50 lb		4
Sinox	Spray	1½ gal, 8 lb. ammonium sulphate, 1 gal diesel oil		5
Sinox General	Spray	1½ pt, 2 gal. diesel oil		6
Sinox General	Spray	2 pt, 3 gal diesel oil		4
Sinox General	Spray	1½ pt, 1 gal diesel oil		6
Sinox General	Spray	3 pt, 5 gal. diesel oil		3
Sinox General	Spray	1½ pt, 5 lb. ammonium sulphate, 2 gals. diesel oil		2
Sinox General	Spray	2 pt, 5 lb. ammonium sulphate, 3 gal. diesel oil		2
Ammonium dinitro butyl phenol	Spray	5 pt, 1 gal. diesel oil		6
Ammonium dinitro butyl phenol		1 gal, 3 gal. diesel oil		4
Ammonium dinitro butyl phenol	Spray	1 gal, 5 lb. ammonium sulphate, 2 gal diesel oil		3
Phosphoric acid[3]	Spray	2½ gal.		6
Phosphoric acid[3]	Spray	5 gal.		6
Phosphoric acid[3]	Spray	7½ gal.		5
Phosphoric acid[3]	Spray	10 gal.		4

[1]1=Leaf blades dead within 48 hours, 2 to 5 inclusive = increasingly less effective, 6 = 90 per cent or more of leaf blades dead 10 days after treatment, and 7 = very little death at 10 days

[2]Furnished by the American Cyanamid Company The nature of the active ingredient has not been disclosed.

[3]Anaconda phosphoric acid analyzing 77 per cent.

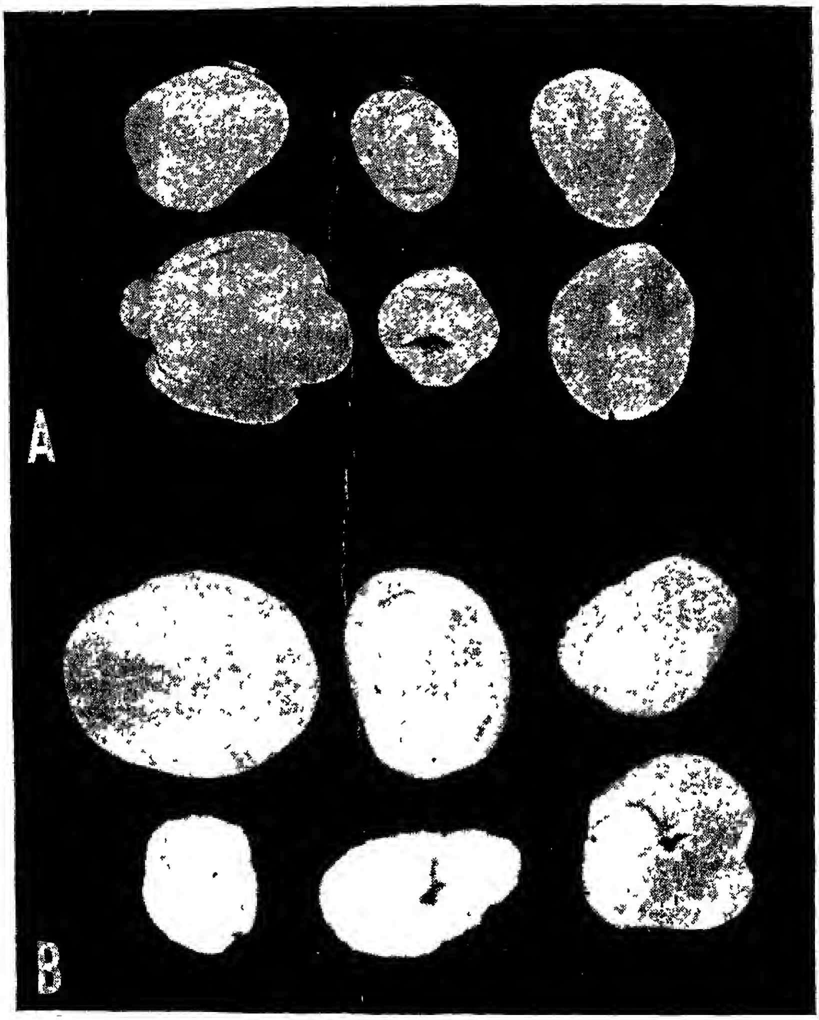

FIG. 1. A. Discolored Red Warbas harvested from vines sprayed with Dowspray 66 Improved. B. Discolored Pontiacs harvested from untreated, cut vines. Normal tubers at upper, left-hand corners.

vascular bundles of tubers sometimes occurs in Maine following the application of vine killers, especially dinitro compounds. His report calls attention to the fact that similar discolorations may sometimes occur in untreated tubers from drought, vine injury, etc., and do not alter the seed value or cooking quality. On the 19th of August, the stems of several untreated Pontiac vines, in the same field and near the plots that were

sprayed with vine killers the same day, were cut on a level with the adjacent soil. When the tubers from these cut vines were examined on the 4th of September, some of them showed the same type of discoloration (Fig 1, B) present in tubers harvested from sprayed vines. The recent report by Otis (3), concerning vine-killing experiments in Oregon, may be cited as further evidence supporting the variable occurrence of discoloration in tubers harvested from plants treated with vine killers Some of the chemicals used in Oregon were also tested in Maine and North Dakota but no discoloration was reported at the former location Although the vine killers may or may not have a direct effect on tuber discoloration, an examination of many potatoes indicated that the rapidity of kill was positively correlated with the amount of discoloration For example, Sinox General at 1½ pts. and 1 or 2 gals. of diesel oil per 100 gals of water was a slow killer (rating of 6) and produced a small amount of tuber discoloration When a more rapid kill was obtained by the addition of ammonium sulphate there was an increase in the amount of discoloration Weed Killer A may be cited as another example When used as a dust it was very ineffective and produced no tuber discoloration but when applied as a spray the discoloration was common. A further observation indicated the amount of discoloration was less when the applications were made later in the season The type of discoloration shown in figure 1 is not the same as that recently described by Larson and Albert (2) or Ross (4). It is also not typical of the discoloration caused by certain *Fusarium* species

Conclusions

1. Nine vine killers were applied as sprays or dusts to potatoes at Grafton, North Dakota, at various times from the 1st of August to the 6th of September, 1946.
2. In the absence of dew, the dusts were not effective.
3. Weed Killer A at 37.5 or 50 lbs. per 100 gal. of water was the most rapid killer.
4. The effectiveness of Dowspray 66 Improved was increased by the addition of aluminum sulphate.
5. The addition of ammonium sulphate to Sinox General and ammonium dinitro butyl phenol increased the rapidity of kill.
6. The discoloration found in and near the vascular (conductive) tissue of tubers harvested from treated vines may or may not be a direct effect of the vine-killing chemicals
7. Tubers harvested from untreated, cut vines showed the same type of discoloration present in tubers harvested from vines treated with vine killers.

8. The amount of discoloration was positively correlated with the rapidity of kill and was less when the applications were made later in the season.

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PROMISING NEW INSECTICIDES FOR CONTROL OF POTATO INSECTS IN WESTERN WASHINGTON

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A dust mixture consisting of 25 per cent calcium arsenate, 25 per cent monohydrated copper sulfate, and 50 per cent hydrated lime has been the standard treatment used in this region for the control of potato flea beetles and late blight. Aphids and leafroll, a virus disease, have caused much concern to potato growers in this area during the past few years. In 1946 several new insecticide-fungicide combinations were tested in an attempt to control the several potato troubles more adequately and, indirectly, to increase production. Data on the effect of certain new materials when mixed with a fixed copper compound were compared with those obtained by the standard control method.

One series of dusts consisted of DDD (1,1,dichloro-2,2-bis(p-chlorophenyl)-ethane), 5 per cent; DDT, 5 per cent; DMT (1-trichloro-2,2-bis(p-methoxyphenyl)-ethane), 5 per cent; and benzene hexachloride (1,2,3,4,5,6 hexachlorocyclohexane), 0.5 per cent gamma isomer. The percentage of toxicant in each dust was based on weight. Each of the above dusts was mixed with Copper A Compound (tetra copper calcium oxychloride) to contain 6.75 per cent metallic copper. The diluent used in formulating the dusts was a commercial grade of talc (Stauffer's Superfine, Stauffer Chemical Co.). To reduce dust drift, one per cent petroleum oil (S A.E. 20) was added to each dust except the standard commercial calcium arsenate.

A second series of dusts consisted of 5 per cent DDT mixed with tetra copper calcium oxychloride (Copper A Compound), 45 per cent copper; tribasic copper sulfate (Tennessee 53), 53 per cent copper; red copper oxide (Stauffer), 80 per cent copper; and tribasic copper sulfate (Acme Kopper King), 52 per cent copper. Copper equivalent to 6.75 per cent was used in each dust. The red copper oxide was very coarse, so a fungicide of finer particles was preferred. The same type of talc and oil was used as in series 1. Data from this series were obtained to check the compatibility of DDT with different fixed copper fungicides.

Insecticide-fungicide combinations were applied as dust as this has been the standard method of application. These were applied by a four-row (engine-propelled) duster at the rate of 15 pounds per acre for the first dusting and the amounts gradually increased as the plants grew until 40 to 45 pounds were necessary when the plants were large enough to cover the space between the rows. The first application of dust was made when 75 per cent of the potato plants had emerged from the ground. Dustings were made on the 6th, 12th and 19th of July, the 4th, 14th and 26th of August and the 8th of September to the Netted Gem variety. Each of these randomized plots located at Arlington, Washington, consisted of eight rows, 135 feet long. Each treatment was replicated six times.

Data were obtained on populations of potato flea beetles, aphids, flea beetle tuber infestation, late blight tuber infection, and yields.

DATA AND DISCUSSION

Flea beetle population and tuber infestation.—The control of adult potato flea beetles[1] was very satisfactory in all eight treatments. This conclusion is based on the number of beetles captured by sweeping the potato plants.[2] More flea beetles were captured in the six plots dusted with the standard calcium arsenate treatment than the sum totals taken from the 42 plots treated with the seven other treatments. Flea beetle populations were extremely low in the plots dusted with DDT and other new insecticide-fungicide mixtures.

The tuber flea beetle larvae (*Epitrix tuberis* Gentner) tunnels into the tuber and may reduce the grade of the potatoes. In this experiment, populations of this species as obtained by sweeping do not show definite

[1]The tuber flea beetle (*Epitrix tuberis* Gentner) and the western potato flea beetle (*E. subcrinita* Lec.).

[2]Ten sweeps with a standard 14-inch collecting net were taken in each plot, or a total of 60 per treatment, on each of the following: 18th of July, 4th, 14th, 19th and 26th of August. Only 4 plots (40 sweeps) were sampled on 7th of September.

relationship with the amount of tunneling. These data are shown in table 1.

TABLE 1.—*Adult flea beetle populations and tuber tunnels in comparable sweep-net and tuber samples, respectively, from plots treated seven times with various insecticide-fungicide dusts. Arlington, Washington*—1946.

Treatment	Number of Adults in 340 Sweeps	Total Number of Tubers Tunneled in 300	Means for Tunnels in 6 Replicates
Calcium arsenate 25 per cent—monohydrated copper sulfate 25 per cent—hydrated lime 50 per cent[1]	39	36	6.0
DDD[2] 5 per cent—Copper A Compound (abbreviated CAC)[3]	4	29	4.8
DMT[4] 5 per cent—CAC	3	54	9.0
Benzene hexachloride[5] 0.5 gamma isomer—CAC	6	21	3.5
DDT 5 per cent—CAC	5	18	3.0
DDT 5 per cent—Tennessee 53[6]	3	29	4.8
DDT 5 per cent—Red copper oxide[7]	7	27	4.5
DDT 5 per cent—Acme Kopper King[8]	3	29	4.8
Difference required for significance (5 per cent level)			3.3
Difference required for significance (1 per cent level)			4.5

[1]Standard calcium arsenate dust—Stauffer Chemical Co., San Francisco 8, California.
[2]DDT supplied by Rohm and Haas, Philadelphia, Pennsylvania.
[3]Supplied by E. I. duPont deNemours and Co., Tacoma, Washington.
[4]Supplied by E. I. duPont deNemours and Co., Wilmington, Delaware
[5]Supplied by E. I. duPont deNemours and Co., Wilmington, Delaware.
[6]Product of Tennessee Corporation, Lockland, Ohio.
[7]Product of Stauffer Chemical Co., San Francisco 8, California
[8]Product of Acme White Lead and Color Works, Detroit, Michigan

Data on the number of tubers tunneled and the number of tunnels per tuber were obtained by paring 50 tubers from each plot. There were never as many as ten tunnels found in any one tuber. The tubers were selected at random from the middle two rows. Potatoes in the plots dusted with the DMT-CAC had the largest number of tubers injured by tuber flea beetle. Reduction in tuber flea beetle infestation was significant in plots dusted with DDD-CAC, DDT-Tenn 53, DDT-red copper oxide, and DDT-Kopper King in comparison with plots dusted with DMT-CAC. The decreased infestation in plots treated with benzene hexachloride-CAC, and DDT-CAC was highly significant as compared with DMT-CAC plots.

Effect of different treatments on aphid populations and disease incidence.—*Macrosiphum solanifolii* (Ashmead). *Myzus persicae.* (Sulzer), and *M. convolvuli* (Kalt.) were the aphids[3] found in the potato plots. Population trends observed during the dusting season from the 6th of July through the 8th of September reached peaks on the 14th and 26th of August. Aphid numbers increased rapidly between the 4th and 14th of August and declined rapidly between the 26th of August and the 7th of September.

The reduction of aphid populations in plots treated with the new insecticides was highly significant as compared with the standard calcium arsenate treatment. There was no significant difference between the mixtures containing new materials in the remaining seven treatments.

Aphid populations were compared in plots treated with the four insecticide materials (series 1), (DDD, DMT, benzene hexachloride, and DDT). Benzene hexachloride-CAC treatment significantly reduced the aphid populations over the DDD-CAC treatment The mean differences in aphid populations between benzene hexachloride-CAC, DDD-CAC, and DDT-CAC treatments were highly significant as compared with the means of aphid populations in the DMT-CAC treatment. A difference of 22.0 in the means of aphid populations (table 2) was significant and a difference of 30 4 was highly significant.

In comparing aphid populations in the plots treated with DDT and different fungicides (Series 2) our analysis shows no significant differences.

Data from this experiment indicate that the different fungicides did not alter the effectiveness of DDT in controlling the aphids on potatoes.

Evidence shows that the incidence of net necrosis was very low in the samples of potatoes collected from the insecticidal-fungicidal plots. The amount of net necrosis did not reduce the commercial grade of the potatoes Plots dusted with calcium arsenate and DMT-CAC showed three tubers in sixty, or 5 per cent, with net necrosis, and it is interesting to observe that aphid populations were the highest in these two treatments

Fungicides as used in this experiment kept the late blight under commercial control In checking the tubers for flea beetle injury, records were kept on the number of tubers infected with late blight. Only six tubers in 2400 examined from samples of all the different treatments

[3]Determinations were made by Dr. G. F Knowlton, Utah State Agricultural College, Logan, Utah

showed evidence of late blight. This infection (table 2) was fairly uniform among the different treatments.

TABLE 2.—*Populations of aphids and amount of disease in different insecticidal-fungicidal plots. Arlington, Washington,* 1946.

Treatment	Aphid Numbers in 300 Sweeps[1]	Number of Tubers Showing	
		Net Necrosis[2]	Late Blight[3]
Calcium arsenate 25 per cent, monohydrated copper sulfate 25 per cent, and hydrated lime 50 per cent	737 5	3	1
DDT 5 per cent—CAC (Copper A Compound)	48 0	0	1
DMT 5 per cent—CAC	98 8	3	1
Benzene hexachloride 0.5 gamma isomer—CAC	19 2	1	2
DDT 5 per cent—CAC	27.5	0	0
DDT 5 per cent—Tennessee 53	35.0	0	0
DDT 5 per cent—red copper oxide	26 0	0	1
DDT 5 per cent—Acme Kopper King	30.8	0	0
Difference required for significance (5 per cent level)	84.2		
Difference required for significance (1 per cent level)	103 0		

[1]Figures are the means of six replications. Ten sweeps per plot (or 60 per treatment) were taken on the 18th of July, 4th, 14th, 19th and 26th of August.
[2]Ten tubers per plot sample or 60 tubers per treatment were examined by Dr. Leo Campbell, Plant Pathologist, Western Washington Experiment Station, Puyallup, Washington
[3]Numbers of tubers showing late blight infection per 300 tubers examined.

Potato yields in plots treated with different insecticide-fungicide combinations.—Yields of harvested potatoes were consistently higher in plots treated with the new combinations than in the standard calcium arsenate treatment. These differences varied from 2442 pounds to 4051 pounds per acre.

Differences of mean yields in all treatments except DMT-CAC show high significance as compared with the standard calcium arsenate treatment. DMT-CAC treatment was significantly better than calcium arsenate treatment. There was no difference in yields between DDD-CAC, DMT-CAC, benzene hexachloride-CAC, or DDT-CAC treatments. Also, when each of the four different fungicides were mixed with DDT there was no significant difference in yields.

Mechanical injury to the potato plants caused by dusting equipment.—Data obtained at harvest time indicated that mechanical injury to the potato plants during dusting applications reduced yields. This

TABLE 3.—*Effect of insecticidal-fungicidal treatment of yields of potatoes. Arlington, Washington*—1946.

Treatment	Mean Yields per Plot	Calculated Yields per Acre
	Pounds[1]	Pounds
Calcium arsenate 25 per cent, monohydrated copper sulfate 25 per cent, hydrated lime 50 per cent	1,740	23,526
DDD 5 per cent—CAC (Copper A Compound)	1,991	26,770
DMT 5 per cent—CAC	1,932	25,968
Benzene hexachloride 0 5 gamma isomer—CAC	2,051	27,577
DDT 5 per cent—CAC	1,981	26,632
DDT 5 per cent—Tennessee 53	1,982	26,645
DDT 5 per cent—Red copper oxide	1,991	26,770
DDT 5 per cent—Acme Kopper-King	1,974	26,535

Difference required for significance (5 per cent level) 145.6
Difference required for significance (1 per cent level) 195 3
[1]Figures are means of six replications.

reduction was 1000 pounds on the acre basis. No appreciable injury to the vines was observed during the first three dustings but as the plants became larger an increasing amount of damage was observed during the last four applications.

The plots consisted of eight rows. The center rows, numbers 4 and 5, were free from injury as only the duster boom and nozzles traversed the plants in these rows. In rows 3 and 6, the tractor and duster wheels injured vines on only one side of the rows. The tractor and duster wheels traveled on one side and the duster wheel on the other side of rows 2 and 7. Because of the dusting arrangement, the tractor wheels made two trips on one side of rows 1 and 8 and the duster wheels made one trip on the other side.

An analysis of these yield data indicated that different intensities of mechanical injury influenced the potato yield. The differences in mean yields were highly significant between rows injured on both sides or twice injured on one side and once on the other side as compared with rows injured on one side or rows not injured by the dusting equipment. Significance in mean yields occurred between rows injured on both sides and rows twice injured on one side and once on the other.

Information from this experiment shows that mechanical injury to the vines by dusting equipment reduced potato yield. Potato fields dusted by the growers would not necessarily give the same results or the same arrangement of variations in injury, as reported above, because of varying types of equipment.

TABLE 4.—*Effect of mechanical injury resulting from the operation of dusting equipment on the yields of potatoes. Arlington, Washington.* 1946.

Amount of Injury	Means of 48 Plot Yields in Pounds
No injury (Rows 4 and 5)	513.5
Injured on one side (Rows 3 and 6)	505.2
Injured on two sides (Rows 2 and 7)	474.3
Injured twice on one side and once on the other side (Rows 1 and 8)	463.4
Difference required for significance (5 per cent level)	10.7
Difference required for sigificance (1 per cent level)	14.2

SUMMARY

Dusts containing DDT, DDD, DMT or benzene hexachloride in mixture with CAC (Copper A Compound) fungicide were superior to standard calcium arsenate mixture for the control of flea beetles and aphids in 1946 at Arlington, Washington. However, tuber infestation by flea beetle larvae was greater in plots treated with the DMT-CAC mixture than in plots treated with any other combination of materials

Net necrosis and late blight were apparently controlled commercially by the different insecticide-fungicide dust mixtures used in 1946

The differences in mean yields of plots treated with DDD-CAC, benzene hexachloride-CAC, DDT-CAC, DDT-Tennessee 53, DDT-red copper oxide, and DDT-Acme Kopper King were highly significant compared with those of plots treated with standard calcium arsenate mixture. Potato yields in plots dusted with DMT-CAC were significantly better than yields in plots treated with standard calcium arsenate mixture.

No significant differences in yields of potatoes were obtained between plots treated with DDT, DDD, DMT or benzene hexachloride when each of these insecticides was mixed with CAC. Effectiveness of DDT, when mixed with four different copper fungicides, showed no significant difference in the control of aphids or in yields of potatoes.

Mechanical injury to potato vines by tractor-drawn dusting equipment reduced the potato yields. Various intensities of mechanical injury caused significant to highly significant differences in potato yields

MERCHANDISING, BY-PRODUCTS AND POTATO PACKAGES

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The potato industry finds itself in 1946 in a position where it is consuming a great many less potatoes than it produces. This year's crop totaled about 474 million bushels, whereas the Government's records of utilization show only about 280 to 300 million bushels entering into the fresh channels of sale annually. The rest of the crop has been going for seed, for livestock feed, for export, for relief, and into various products and by-products. When production was averaging around 400 million bushels or less, these outlets were required to consume roughly 100 million bushels. Present production figures require that outlets be found for an additional 80 million bushels.

The problem of making potato supply and demand meet involves either increasing all forms of consumption, decreasing production, or both. Much has been said about a crop control program for potatoes, involving both acreage reduction and some form of penalty for marketings in excess of quotas Too little has been heard about permanent long-range efforts to increase consumption of fresh potatoes, manufactured potato food products, and non-food by-products. Although it is clear that consumption cannot overtake present levels of production immediately, there is no reason why a broad campaign for utilization will not yield favorable results.

Per capita consumption of potatoes, according to Government figures, has been declining for several years. In the five-year period ending in 1929, it was 156 pounds. Five years later it was 147 pounds. In 1934, it had declined to 138 pounds, and in 1939, had reached the low figure of 131 pounds. It should be noted that the consumption of practically every other fruit and vegetable, except apples, had enjoyed a steady increase. Citrus consumption during the same period went up from 29½ pounds per capita to 48.7 pounds It so happens that during that period some 40 million dollars was invested in advertising and sales campaigns on citrus fruits. Potato consumption has suffered partly because of poor grading and unattractive packaging, partially from the aggressive competition of other starchy foods, somewhat from the prevailing opinion that potatoes are fattening, but most of all from the lack of a concerted merchandising effort on the part of the potato industry itself. As for the development of potato food products, this

has resulted, with one of two significant exceptions, principally from the efforts of independent processors outside the fresh potato business. Dehydration developed rapidly during the war, and is now undergoing a downward readjustment to peacetime conditions. The potato chip industry has grown rapidly, in spite of wartime shortages of fats and oils, and now consumes about 15 million bushels of fresh potatoes annually. It is doubtful if the sale of potato flour and meal has any more than kept pace with the increased population, wartime expansion considered. Some developments are taking place in the field of frozen cooked potatoes and it may be said that these show great possibilities, but more research along these lines is necessary.

What is being done to increase the consumption of fresh potatoes? One of the most promising projects, so far as this organization is concerned is found in the work of United's Merchandising Institute It has been proved, through a carefully conducted commercial research program, that the sale of all fresh fruits and vegetables can be increased by the application of certain tested principles in retail stores. It has been found that there is a balance within a retail fruit and vegetable department as to the quantities of different fruits and vegetables purchased by the average consumer. When this fact is recognized and the retail store undertakes a definite program of merchandising along carefully-planned lines, startling increases in sales volume have occurred. In other words, the sale of potatoes at retail can be increased as a part of the program of increasing the sale of all fresh fruits and vegetables at retail.

Following a year of careful preparation in a number of wholesale markets, United held at Kansas City, last November, a two-and-one-half-day Merchandising Clinic attended by nearly 300 industry men from the United States and Canada. Here the proven systems and methods required for setting up a successful and profitable green-grocer department in the retail store were carefully explained, studied, and discussed Even though such a meeting may seem a small beginning, the enthusiasm with which the idea has been received is very promising for an extension of its principles The fresh fruit and vegetable industry is nothing if not a chain of more or less independent links. Unlike other businesses, it is seldom under vertical control, but consists of different operations managed by different groups. Even though you can pull a chain successfully, nobody ever got very far trying to push one. For that reason, the United Merchandising Institute goes first into the retailer's place of business to find out why there is not a strong pull through his green-grocery department, to find out

where the bottlenecks are, and to help him reorganize his produce business on a sound basis.

How can potato consumption be increased in manufactured food products? It has already been pointed out that some progress has been made in selling more chips, more frozen French Fries and certain processed potato products designed for the preparation of quick meals Clearly more research, both public and private, is needed, in the development of these products, in finding their markets, and in publicizing them through both advertising and public relations programs. The potato chip manufacturers present an excellent example of aggressiveness along these lines.

In the manufacture of potato by-products, such as alcohol, starch, livestock feed, etc, a vicious circle is encountered Manufacturers are unable and unwilling to invest capital in processing equipment and factories where a reasonably steady supply of raw materials cannot be assured On the other hand, the industry has done practically nothing in an organized way to keep its culls and off-grades off the fresh market and to make them available at salvage prices to such outlets. Some way must be found to get this chain of supplies, production and use into circulation.

We have seen this year some 20 million bushels of surplus potatoes manufactured into beverage alcohol and more than six million bushels into industrial alcohol This was a piece of luck to the potato industry and the Government, caused by the world-wide shortage of grain; but the large grain crops of the past summer have turned the distilleries away from the use of potatoes. So long as Government subsidy is to be applied to the handling of potato surpluses, and this has been the case for over twelve years, many express the belief that Government-supported manufacture of alcohol for potatoes is not impossible. Its use as a blend in motor fuel has long been a distinct possibility.

Research is under way to determine whether potato starch, as such, has any uniquely advantageous qualities It competes with starch from corn and from various plants grown in the tropics, which tends to keep it on a low price basis The only exception seems to be its use in the textile industry Similar research is under way as to the possible development of crude glucose to be made from cull potatoes and used in the manufacture of livestock feed. More activity is needed to develop this outlet. Foreseeing the need for stimulation from within the industry, of both private and public research, United established, almost a year ago, a permanent committee for the promotion of research and by-products use. This committee, with membership representative

of many potato-producing areas, has already undertaken a broad program to translate its objectives into accomplished facts. Much more remains to be done.

The whole problem of increasing potato consumption, whether in fresh form, in food products, or non-food by-products, is tied up with the matter of warehousing, grading, and packaging A greater volume of attractively packed and well-graded potatoes in the retail store would increase consumer demand. At the same time, the culls and off-grade withheld from these offerings would provide the basis for a permanent by-products industry The development of new uses, both food and non-food, awaits only the intelligent application of research principles in both Government and private laboratories. After years of Governmental expenditures to support potato prices, it should now be clearly apparent that one of the most promising and effective sources of relief would be the activity of the industry itself in finding and applying the answers.

SECTIONAL NOTES

ALABAMA

The potato growers in Alabama have experienced most peculiar weather conditions this season. January resembled April. February was the coldest in more than 40 years, according to the Mobile weather bureau March has been cold and wet with storms which usually produced 4 to 6 inches of water about once a week. Early March gave us temperatures that were so near freezing that growers had the blues. Hail has done a considerable amount of damage in certain small areas Despite all this, the prospects seem to be about normal according to well-informed growers and dealers. Doubtless some loss of fertilizer has occurred, water has damaged a certain amount of low areas, and the entire crop is, as of today, a week to ten days behind our normal planting period.

No late blight has been reported to date That is probably due to the winds that have more or less kept the plants dry during the day or to the fact that our crop is not far enough developed. Very little has been done so far for the control of blight because of weather conditions in March Most of the potatoes will either be dusted or sprayed for blight control There is a tone of confidence among most of the growers about blight. They used the best seed they could secure, planted most of the crop within a 10-day period, and have made special efforts to give proper drainage to fields where it was possible. In other years

these practices have paid dividends to the growers Should blight be found soon, and everybody expects it will be, most of the growers will attempt control measures in earnest.

It has been announced that the Potato Tour will be had again this year for the first time since the beginning of the War. Details have not been announced, but are being worked out at this time This has been and doubtless will be an important event in South Alabama. In the past the Tour was held just before the opening of the sheds for business

Most of the Certification Samples and Index plantings at the Gulf Coast Substation have not been damaged by the weather. Observations for plant diseases will begin next week. (Apr. 6)—FRANK E. GARRETT.

CALIFORNIA

Other potato-producing areas are probably waiting for an announcement of the acreage of potatoes planted in Kern County for 1947. No survey has yet been completed for this county and anybody's guess is about as good as another's. Generally speaking, the consensus of opinion at the present time is that the acreage will be between 47,000 and 52,000 acres planted in the floor of the valley, with approximately 2700 acres yet to be planted in the mountain area The early section in the Edison district is now up and in some fields the rows are completely filled by the plant growth. All growers in the Edison district have their fingers crossed with reference to frost. Frost could happen in this area as late as the 15th of April. We have no frost, to date, since the potatoes were out of the ground and the plant growth in most fields looks very good.

This is a considerable reduction in acreage from last year, when we harvested approximately 65,000 acres. Many seed growers sold seed for commercial consumption this year By this time next month the diggers will be running and new potatoes from this area will be rolling in car lots to various portions of the United States (Mar 24).—M. A. LINDSAY

GEORGIA

There is very little potato information in Georgia that would make news at this time. Several of the counties in northern Georgia are now receiving car lot shipments of certified seed potatoes. I do not know how many of these cars will be used in the state as yet. More preparation is being made on disease control on the potato crop than has been done before. (Apr. 4).—ELMO RAGSDALE.

INDIANA

Judging from the inquiries we get concerning potato seed, it looks as if almost every one in Indiana is going to plant during the season of 1947 The main requests to date are for the Sebago and Sequoia seed,—with a few spattering reports of Katahdin and Irish Cobbler. There is a very definite trend toward these varieties, in which people are asking for quantities varying from a few hundred pounds to carloads of them. There seems to be very little seed available at this time, unless some one is holding out.

Most of our potatoes will be planted from the middle to the latter part of May. The early crop of Irish Cobbler in the southern part of the state has already been planted and the growers in central and northern Indiana are preparing their ground for their main crop, which will be planted on muck during the latter part of April

Those who deal in potato seed need to be re-educated as to the demands, and it makes it rather difficult for the small grower to buy limited amounts of seed when he doesn't need a carload. I hope this situation does not prevail elsewhere (Apr 1) —W B. WARD.

KENTUCKY

Potato planting began on the 11th of March From preliminary intentions to plant, it appears that the state's commercial average will be reduced about 12 per cent (Mar. 21) —JOHN B. GARDNER.

MAINE

Although Maine continues to be in the headlines because of the amount of potatoes dumped this winter, much of the criticism is unjustified Potatoes which were dumped were deteriorating or were endangering other potatoes.

Maine has supported the export deals to the fullest extent Dealers and farmers furnished potatoes for the export deal at support prices even though the potato market was often above support price. This was a real sacrifice to some, but dealers and farmers believed they were under moral obligation to make the potato program work even though at times it meant a sacrifice on their part.

Maine furnished 7394 cars of potatoes to the export deals by the 1st of April. Maine shipments for March smashed all existing records Several days during the month shipments exceeded 600 cars Some estimate that Maine may ship about 56,000 cars this year. In 1946 Maine shipped 54,301 cars.

Potato allotments have been forwarded growers by the A. A A

It is believed that nearly all farmers will participate Many farmers are asking for higher goals but acreage has been allocated, so few, if any, increases can be granted Maine's allotment is 186,000 acres for 1947. Last year's acreage was 219,000 acres.

Indications are that a Marketing Agreement is being considered for the 1947 crop, among other support features. Some farmers are interested but few know anything about it

A bill was introduced into the legislature to increase the state potato tax from one to two cents per barrel Provisions of the bill were explained at a series of meetings throughout Aroostook County The attendance was not high, but the farmers present voted about two to one against any increase The bill was, therefore, withdrawn. (Apr. 5).—VERNE C. BEVERLY.

MICHIGAN

April has finally arrived as it always does here in Michigan, and March is over March is a month we always like to have behind us. This year it came in like a lion, and went out a much bigger lion

The potato market has been dull all season, with shipments below those of a year ago, although there was a much larger crop to move The government program for removing surplus was slow in starting, and is still moving slowly with much confusion There was some dumping of low grade stock and sales for livestock feeding,—followed by shipment on foreign orders,—which helped considerably. Bad roads and storms hampered these programs The present foreign program is scheduled to end the 7th of April, and Michigan is going to need further help to dispose of its surplus

Our certified seed movement has been slow, and it does not seem likely that sales will equal those of last year.

With the hiring of a full-time secretary-manager, the Michigan Potato Development Association has launched an active program to improve the grading and inspection of potatoes in the state This is to be followed by a merchandising campaign, built around a quality consumer package, stamped and approved by the Association (Apr 5) —H. A. REILLEY.

NEW JERSEY

From all the information received to date it seems that a very large percentage of New Jersey growers will comply with their acreage allotments and that the 1947 acreage will be very close to the 56,400

acres that have been allotted to growers. Few growers are inclined to take a chance on producing potatoes that are not eligible for price support, since the Department of Agriculture has announced that it may sell surplus potatoes on the market at prices below support.

A few growers planted some potatoes last week, but on the whole most of our growers are afraid to venture because of the low temperatures that have existed. With warmer weather in prospect it is anticipated that planting will possibly get under way throughout the state within a week, with the exception of the northern portion

Marketing agreements suggested by the U. S D. A. are definitely out for this year's crop in New Jersey because of insufficient time to make all the necessary arrangements according to advice from a P. M. A. meeting held in New York City last week (Apr. 5).—J. C. CAMPBELL.

NEW YORK

As this is being written, on the 1st of April, the ground is covered with snow and morning temperatures run as low as 4 degrees. Some of our main highways are practically one-way highways because of snow banks A year ago last week a lot of oats was sown but this year it looks like it will be three or four weeks before we can get on the ground. In other words the season is late.

Intentions to plant for New York State are indicated as 88 per cent of last year but actual plantings may be less than this There is a strong attitude at present toward reducing acreage.

Seed movement has been slow because of the weather, delays in getting out farm acreage allotments and an uncertainty as to the general situation. Table stock business has been good at prices competing with support levels.

Much interest is being expressed in the recent announcement of the 1947 program Most growers are very much in favor of giving the public a better grade of potatoes

Marketing agreements are being discussed in a series of meetings this week. Preliminary advices indicate that growers are concerned about the operation of marketing agreements unless some special arrangements can be made to take care of low grades and off sizes With so many markets so close by there will be a strong tendency for these fringe grades to find an outlet.

Much interest is being shown in new varieties, especially Teton of which about 2000 sacks are being planted for certification Besides its resistance to ring rot it has been found to be an excellent keeper, high

yielder and a better potato for shipping than any of our standard varieties including Russet Rural.

The Erie which is a sister of Teton is also becoming popular because of its good keeping qualities as well as high yielding ability and resistance to ring rot.

All available supplies of the blight immunes will be planted and it is expected that some will be available for distribution next year. Virgil, Essex, Madison and Chenango seem to be in greatest demand. (Mar. 31).—W. G. EVANS.

OHIO

The weather has warmed during the past few days and planting of the early crop is just starting. Our planting operations will be about 15 days later than a year ago. The acreage in Ohio is expected to be approximately the same as last year.

It looked for awhile as if some of the Russet potatoes in this state would have to be dumped. During the heavy snow in the East, shipments from out-of-state areas were practically stopped and during that period the markets took all of the Russets so that the old market in this state has cleaned up and there have not been any local potatoes on the markets for about two weeks. (Apr. 4).—E. B. TUSSING.

RHODE ISLAND

The 1946 potato crop is just about cleared up, much to every one's relief. Potatoes have moved much better than anticipated during the past few weeks Many dairy farmers are regretting that there are no more available for cattle feed. They claim that they can not keep up milk production without them, regardless of what other feed they have This may prove to be a valuable outlet for the poorer grades of potatoes in the future, now that the dairy farmers have learned of their value.

A group of potato growers got together at the Southern New England Farm and Home Show and organized the Rhode Island Potato Growers' Association. The Executive Committee has held two meetings since its organization. This committee is placing most emphasis on ways and means of improving the marketing program in the state. By the way, the growers had a very attractive exhibit at the Show,—advertising their product.

Newport County growers are well under way with their planting. Many plan to finish by the end of next week. Spring is opening up rather slowly in Southern Rhode Island. It will be another ten days before many potatoes will be planted. Most growers are planning to

stay within their allotments in order to be eligible to participate in the price support program.

A study of the fertiliy levels of Rhode Island potato soils has been made, and the chemical tests show that reserves of phosphorus and potash have been built up in the soil, especially where potatoes have been planted continuously for a number of years Plans are under way to carry out careful fertilizer studies on at least four farms to determine the proper ratio and amount of fertilizer to use for most profitable production. (Apr. 5).—AVERY E RICH.

SOUTH DAKOTA

Potato acreage goals have been released to growers in South Dakota and are slightly lower than the 1946 acreage. South Dakota growers have been reducing their acreage, so the 1947 goals will not cripple any of the commercial producers.

The 1946 crop is about cleaned up. Approximately 200,000 bushels were piled in fields last fall by producers who lacked storage, and about 200,000 bushels were dumped during the winter, where the potatoes were deteriorating because of disease or crowded storage conditions

Recently 101 carloads of white potatoes were shipped from South Dakota to Beaumont, Texas, for export as seed potatoes to Germany.

At the annual meeting of the South Dakota Potato Growers' Association, Chas. A. Larkin of Clark was re-elected Chairman; David Giese, formerly of Moorhead, Minnesota, head inspector, has established an inspection office at Clark.

Indications are that the acreage to be entered for certification will be around 7,000, about the same as in 1946, but less than the acreage entered in 1945 A number of cars of foundation Triumph and Cobbler seed have been secured from Wisconsin, Minnesota and North Dakota.

Growers feel that the Government support program has helped them over some rough spots, and they have under consideration, a marketing agreement, for the 1947 crop, where culls and grade outs will be kept off the market. (Apr. 3).—JOHN NOONAN.

WASHINGTON

The commercial potato market in Washington has been stimulated by the volume purchased by the Government for dehydrating Over 700,000 tons of potatoes have been purchased in Washington, Idaho and Oregon to be dehydrated at the plant at Lynden, Washington This tonnage will produce more than 120,000 tons of dehydrated material for European shipment. Individual allotments have been set up and the growers have been very cooperative in signing up.

It has been indicated that plantings this season will be approximately 86 per cent of the 1946 crop. Our test plot readings made at Oceanside, California, during February indicate that the seed grown this year is the best that has been offered for sale since test plot work started. There will be more Netted Gem and White Rose foundation seed available this year than the market will absorb. (Apr. 7).—HAROLD S. SCHAAD.

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EXACT WEIGHT Scale Sales to potato men are up sharply, not in just one section but nationally. More and more distributors are following the trend of better packaging and accurate weighing for uniform bags. The biggest increase last year was in small consumer bags up to 15 lbs. by both growers and brokers alike. The most popular scale used was EXACT WEIGHT Model #708-P (illustrated). A lot of potatoes were sacked in 100 lb. bags too. No matter how you package there is an EXACT WEIGHT Scale for the job. Write for details.

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FIELD TESTING OF DISINFECTANTS FOR THE CONTROL OF POTATO RING ROT BACTERIA ON WOODEN AND METALLIC SURFACES

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INTRODUCTION

Ten years ago, when potato ring rot was first discovered in the United States, uncertainty existed concerning its importance. Now a decade later, the disease is recognized as ranking among top troubles in the production of potatoes.

Its control, however, is relatively simple, consisting of but three steps: 1) removal of all potato stocks from the infected farm; 2) disinfestation of all surfaces having come in contact with the diseased potatoes; and 3) procurement of new seed stocks that are free from ring rot. If properly carried out, this three-point program will eradicate ring rot virtually overnight.

Failure, however, results when one or more of these requirements is neglected. Step No. 1—the removal of all potatoes—is simple to follow and will start the way to successful clean-up provided no exception is made to the word "all." This means getting rid of table-stock and home-use lots as well as seed lots supposedly healthy or not.

Step No. 2—the disinfestation of all surfaces having come in contact with infected potatoes—is more difficult to practice. It involves knowing what surfaces should be cleaned, and what chemicals to use in the process.

Step No 3—the procurement of new seed free of the disease—can best be followed at present by use of certified seed. While such seed has at times been found to contain ring rot, its use still offers the only available solution to the replacement problem on a commercial scale. Much remains, however, to be done under Step 3 by seed improvement agencies Foundation stocks should be developed which are laboratory-tested and *known* to be free of the disease.

Procedures and Results

The results presented in this report bear on the chemicals to be employed in eradicating ring rot. In the past, success of the three-point program has often been jeopardized by use of analogies concerning disinfectants to be applied For example, formaldehyde has been recommended for ring-rot disinfestation because of its general bactericidal efficacy elsewhere. Yet when tested against ring rot, formaldehyde was found by several investigators (Starr, 1940; Scott *et al*, 1941; Knorr 1944) to afford not only *no* control, but actually to cause a spread of ring rot Other recommendations, also of dubious reliability, have been based simply on laboratory tests Because copper sulfate was found to kill pure cultures of *Corynebacterium sepedonicum* on toothpicks, it has been concluded that copper sulfate could be used to clean up crates and walls of storages This paper summarizes work conducted over the past four years in evaluating bactericides for the control of ring rot bacteria *under field conditions*. Since no one experiment can anticipate all variations in field practice, the attempt has been made in these tests to make each trial as severe as possible

The three types of ring-rot harboring surfaces encountered in potato production are wooden, metallic, and fibrous. Of these, the first two only are dealt with here The disinfestation of fibrous bags has already been reported on by others; and recommendations that have been made are well grounded in experimental results Some examples of wooden surfaces encountered in potato production which may be contaminated with the ring-rot bacterium are: crates, baskets, barrels, weighing platforms, warehouse walls, and truck bodies Metallic surfaces include scoops, diggers, graders, washers, elevators, cutting knives, and planters.

Disinfestation of Wooden Surfaces

In the testing of wood disinfectants, field conditions were simulated by the use of wooden potato crate slats 2 inches wide and 14 inches long, each of which was rubbed vigorously with a ring rot diseased potato. In this manner the pathogen together with the attendant ooze and tuber

tissue was worked well into the wood. The inoculated slats were then allowed to dry for 24 hours. Following this they were divided into lots of 40, submerged 1 minute in the various solutions being tested, and allowed to dry. Checks went untreated. Twenty-four hours after removal from the dips, the slats were rubbed with the freshly cut surfaces of healthy potatoes, in this way picking up whatever ring rot bacteria had survived the treatment. Using precautions against recontamination, the cut seed were placed by hand in randomized rows 100 feet long and in 4 replications. Wilting of infected hills or visible tuber rotting (as variously indicated in table headings of the different tests) was taken as the index of ring rot.

Table 1 presents results obtained from comparing copper naphthanate (Green CUPRINOL brand), chlorinated phenols (PERMATOX F brand), an approximately equal mixture of lauric and myristic fatty acid esters of colamino formyl methyl pyridinium chloride (EMULSEPT brand), alkyl dimethyl benzyl ammonium chlorides (ROCCAL brand), copper sulfate, mercuric chloride and calcium hypochlorite with an untreated check. All treatments gave significantly less ring rot than the untreated check. However, complete control (*i.e.,* complete disinfestation) was obtained only in the case of copper sulfate, mercuric chloride, and ROCCAL at the concentrations indicated in the table. The use of copper naphthanate and chlorinated phenols was inhibitory to corking over of the seed, and this resulted in a subsequent reduction in stand.

Table 2 compares the disinfecting abilities of various concentrations of alkyl dimethyl ammonium chlorides (ROCCAL brand) and of diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammounium chloride (HYAMINE 1622 brand), copper sulfate, coal tar phenols (PRATT'S Stock Dip brand) and a 6 to 10 per cent ammoniacal solution of copper-zinc-phenol (ACZOL brand) with an untreated check. ROCCAL, which previously gave complete control at 1:500 is here represented by dilutions of 1:50,000 and 1:100,000, neither of which was adequate for control HYAMINE 1622 at dilutions of 1:20,000 and 1:40,000 failed to produce control significantly better than the untreated check. Copper sulfate, previously used at the rate of 2 pounds in 10 gallons water to give complete control, was this time tested at 1 pound in 10 gallons—and again the control was absolute. The coal tar phenols at 1:25 and ACZOL at 1:10 also produced complete control

Disinfestation of Metallic Surfaces

In testing disinfectants for metallic surfaces, metal parts harboring ring-rot bacteria such as planters, diggers, etc., were simulated by screws 2 inches long and No. 8 in diameter. These were thrust into the vas-

TABLE 1.—*Comparison of 7 treatments for the disinfestation of wooden surfaces for the control of potato ring rot.* (*Messrs. C. and R. VanDuser farm, Auburn, N. Y.*)

DISINFECTANT	CONCENTRATION	HILLS/FOUR 100-FOOT REPLICATIONS		
		Healthy	Diseased	Total
1 CUPRINOL Green	Undiluted	212	6**	218**
2. PERMATOX F	1 10	202	5**	207**
3. EMULSEPT	1:500[1]	284	10*	294
4. ROCCAL	1:500[1]	256	0**	256**
5. Copper sulfate	2#/10 gals water	282	0**	282*
6. Mercuric chloride	1:500	295	0**	295
7. Calcium hypochlorite	5000 ppm avail. Cl_2	330	2**	332
8. Untreated check		300	33	333

*Significantly different from "Untreated checks" at 5 per cent level.
**Significantly different from "Untreated checks" at 1 per cent level.
[1]Based on active ingredient.

Variety: Katahdin (New York State Certified)
Date planted: May 27, 1944.
Date final ring rot reading: September 19, 1944.

TABLE 2.—*Comparison of 7 treatments for the disinfestation of wooden surfaces for the control of potato ring rot. (Kenneth MaGahan farm, Cooks, Michigan.)*

DISINFECTANT	CONCENTRATION (Active Ingredient)	HILLS/FOUR 100-FOOT REPLICATIONS		
		Healthy	Diseased	Total
1. ROCCAL	1:50,000	287	34	321
2. ROCCAL	1:100,000	268	40	308
3. HYAMINE 1622	1:20,000	298	26	324
4. HYAMINE 1622	1:40,000	242	20	262*
5. Copper sulfate	1#/10 gals. water	230	0**	230**
6. Coal tar phenols	1:25[1]	257	0**	257*
7. ACZOL	1.10[1]	229	0**	229**
8. Untreated check	—	295	24	319

*Significantly different from "Untreated checks" at 5 per cent level.
**Significantly different from "Untreated checks" at 1 per cent level
[1]Concentration based on retail stock solution.

Variety: Pontiac No systemic ring rot encountered while cutting 3200 seed pieces, nor was the disease observed in the 100 hills hills planted to whole, uncontaminated seed.
Date planted: June 14, 1946
Date final ring rot reading. September 9, 1946

cular region of ring-rot-diseased potatoes, and upon withdrawal the threads were well packed with a mixture of organic matter and bacteria, thereby affording an unusually severe test of the disinfecting ability of the chemicals being studied. The screws were then allowed to dry from 12 to 24 hours, after which time the debris between the threads appeared dry. Forty contaminated screws were so prepared for each disinfectant tested, placed on a metal screen, immersed in the appropriate chemical for 1 minute, and then allowed to dry for 24 hours. Check screws were not disinfested.

At the end of the 24-hour drying period, seed pieces cut from ring-rot-free potatoes were pierced with these screws so that the threads passed through the vascular ring. Each screw was used to inoculate 10 seed pieces, and 400 seed pieces were prepared for each treatment. Planting was done in 100-foot rows, four randomized replications to the plot.

Table 3 shows the number of healthy and diseased hills resulting from this procedure with the following chemicals: copper sulfate, calcium hypochlorite (PERCHLORON brand), alkyl dimethyl benzyl ammonium chlorides (ROCCAL brand), formalin, and pentachlorphenol (SANTOPHEN 20 brand). Using the same technique, various other disinfectants were tried as reported in table 4; these were alkyl dimethyl benzyl ammonium chlorides (ROCCAL brand), an approximately equal mixture of lauric and myristic fatty acid esters of colamino formyl methyl pyridinium chloride (EMULSEPT brand), di-isobutyl cresoxy ethoxy ethyl dimethyl benzyl ammonium chloride (HYAMINE 10x brand), alkyl dimethyl 3, 4- dichlorobenzyl ammonium chloride (TETROSAN brand), lauryl isoquinolinium bromide (ISOTHAN Q-15 brand), phenyl mercuri triethanol ammonium lactate (PURATIZED brand), and sodium paratoluene sulfonchloramide (STERI-CHLOR brand). Some of the foregoing chemicals were also tested at intermediate concentrations, but due to late planting and early frost-killing of the plots, insufficient ring rot developed even in the checks to warrant gathering data.

Conclusions and Discussion

In summarizing the above results on wood disinfectants, it can be said that at proper dilutions complete eradication of wood contamination was obtained by use of copper sulfate, mercuric chloride, coal tar phenols, alkyl dimethyl benzyl ammonium chlorides, and an ammoniacal copper-zinc-phenol solution. Incomplete control at the concentrations tested resulted from the use of copper naphthanate, chlorinated phenols, N(higher acyl esters of colamino formyl-methyl) pyridinium chloride, calcium hypochlorite, and di-isobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride .

TABLE 3.—*Comparison of 5 treatments of metallic surfaces for the control of potato ring rot. (Harry Wagner farm, Baldwinsville, New York.)*

DISINFECTANT	CONCENTRATION	HILLS/FOUR 100-FOOT REPLICATIONS		
		Healthy	Diseased	Total
1. Copper sulfate	2#/10 gals. water	381**	0**	381
2. Calcium hypochlorite	5000 ppm avail Cl_2	374**	10**	384
3. ROCCAL	1.1280 (act. ingred.)	374**	5**	379
4. Formalin	1:10	375**	0**	375
5. Pentachlorphenol	2 per cent	373**	6**	379
6. Untreated check	—	247	130	377

*Significantly different from "Untreated check" at 5 per cent level.
**Significantly different from "Untreated check" at 1 per cent level.

Variety: White Rural (New York State certified).
Date planted: June 13, 1944.
Date final ring rot reading: September 25, 1944.

TABLE 4.—*Comparison of 7 disinfectants of metallic surfaces for the control of potato ring-rot. (Lawrence Lindstrom farm, Iron River, Michigan.)*

DISINFECTANT	CONCENTRATION (Active Ingredient)	LBS. TUBERS/FOUR 100-FOOT REPLICATIONS		
		Healthy	Diseased	Total
1. ROCCAL	1:1000	356.5	0	356.5
2. EMULSEPT	1:1000	364.5	0	364.5
3. HYAMINE 10X	1:1000	364.0	0	364.0
4. TETROSAN	1:1000	357.0	1.0	358.0
5. ISOTHAN Q-15	1:1000	351.0	0	351.0
6. PURATIZED	1:1000	347.5	0	347.5
7. STERI-CHLOR	2000 ppm avail Cl_2	360.0	2.5	362.5
8. Untreated check	——	314.5	17.4	331.9

Variety: Pontiac. No systemic ring rot encountered while cutting 3200 seed pieces, nor was the disease observed in the 100 hills planted to the whole, uncontaminated seed.
Date planted: June 6, 1946.
Date harvested and read: September 12, 1946.

It appears from the data that some wood disinfectants cause significant reductions in stand or yield. It must be remembered, however, that the freshly cut surface of each seed was rubbed over the slats within 24 hours of treatment and that in this way a considerably greater amount of chemical was picked up than would ordinarily occur under field conditions. A hazard of a more serious sort did arise with the use of chlorinated phenols and copper naphthanate, these chemicals with their organic solvents inhibited corking-over almost completely and reduced the cut surfaces of seed to layers of slime within 24 hours.

As just pointed out, there are a number of chemicals that will completely eradicate ring rot contamination. From an extension worker's standpoint, however, the easiest of these to recommend is copper sulfate (1 pound in 10 gallons water). Blue vitriol has the advantages of being cheap and being readily available; furthermore, it is a fair wood preservative, thereby enabling the user not only to kill contaminating bacteria but at the same time to preserve his storage walls and crates.

Summarizing the data on metal disinfectants, it can be stated that ring rot contamination is inactivated on planters, diggers, graders and other metallic surfaces by alkyl dimethyl benzyl ammonium chlorides, N(higher acyl esters of colamino formyl methyl) pyridinium chloride, di-isobutyl cresoxy ethoxy ethyl dimethyl benzyl ammonium chloride, lauryl isoquinolinium bromide, phenyl mercuri triethanol ammonium lactate, formalin, and copper sulfate And again, as in the case of wood disinfectants, copper sulfate lends itself most readily to recommending because of its cheapness, availability, and because it is one chemical that these tests show to be effective on either wooden or metallic surfaces. One drawback to the use of copper sulfate on metal is that it causes corrosion. Its corrosiveness, however, is belittled by most growers who have used it on their machinery. For those, however, that do object to such rusting as does take place, use of the non-corrosive quarternaries or formalin is indicated.

Summary

Field data are presented comparing the efficacy of various disinfectants for the inactivation of ring rot contamination on wooden and on metallic surfaces.

Slats of potato crates were inoculated with ring-rot ooze and disinfested in various chemicals. Cut surfaces of healthy seed were then rubbed over the slats to pick up any remaining viable ring-rot bacteria. The seed was planted in randomized replicated rows, and evidence of ring rot survival derived from wilted vines or affected tubers. Disinfec-

tants for wooden surfaces tested in this manner were 1) copper sulfate, 2) mercuric chloride, 3) coal tar phenols, 4) alkyl dimethyl benzyl ammonium chlorides, 5) ammoniacal solution of copper-zinc-phenol, 6) copper naphthanate, 7) chlorinated phenols, 8) N(higher acyl esters of colamino formyl-methyl) pyridinium chloride, 9) calcium hypochlorite, and 10) di-isobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride. Of these at the concentrations tested, only the first five gave complete control.

Disinfectants for metalic surfaces were tested, using screws to simulate such appurtenances of potato production as planters, diggers, and graders. Inoculated and treated screws were thrust into the vascular region of healthy seed, and the seed planted and observed as in the preceding paragraph. Disinfectants for metallic surfaces tested in this manner were: 1) copper sulfate, 2) formalin, 3) alkyl dimethyl benzyl ammonium chlorides, 4) N(higher acyl esters of colamino formyl methyl) pyridinium chloride, 5) di-isobutyl cresoxy ethoxy ethyl dimethyl benzyl ammonium chloride, 6) lauryl isoquinolinium bromide, 7) phenyl mercuri trienthanol ammonium lactate, 8) alkyl dimethyl 3, 4-dichlorobenzyl ammonium chloride pentachlorphenol, 9) sodium paratoluene sulfonchloramide, 10) calcium hypochlorite, and 11) pentachlorphenol. Of these at the concentrations tested, only the first six afforded complete control.

Although other chemicals gave control equal to copper sulfate, the latter is the most logical disinfectant to recommend by virtue of its cheapness, its general availability, and its applicability to both wooden and metallic surfaces. Effective concentration for wooden surfaces was found to be 1 pound copper sulfate in 10 gallons water, and for metallic surfaces, 2 pounds in 10 gallons. Data on the 1-pound-per-gallon rate for metallic surfaces are missing.

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THE EFFECT OF DIFFERENT CONCENTRATIONS OF BACTERIAL SUSPENSIONS USED IN INOCULATIONS UPON SUBSEQUENT RING ROT SYMPTOMS IN THE POTATO PLANT

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The appearance of small amounts of ring rot in certain lots of potatoes has been a basis for speculation as to how and when infection occurred. Moreover, the question arises, "Can slight infection occur in Bliss Triumph or other susceptible potato tubers,—so slight that symptoms may not develop in the plants or tubers that season but yet be sufficient to carry through to the crop the following year or years when definite symptoms will appear?"

With this in mind, an experiment was begun in 1945 to discover the effect of different amounts of inoculum on the subsequent development of ring-rot symptoms in the potato plant.

EXPERIMENTAL METHODS

A bacterial suspension was made by using 3.25 grams of ring-rot ooze from infected potato tubers to 100 cc. of distilled water. This suspension was used in the following concentrations: full strength, 1:2, 1:4, 1:8 and 1:16. Two methods of inoculation were used for each concentration,—that of eye inoculation (stabbed) and that of leaving the cut seed pieces in the bacterial suspension for a period of ½ minute. The seed pieces were then planted in field plots, 10 seed pieces per row, replicated twice. The plants were inspected several times during the summer for ring-rot symptoms.

In 1946 two similar experiments were conducted but with slight modification. (Exp. 1). The suspension was made by adding 7 grams of bacterial ooze to 250 cc. water. Only one method of inoculation was used,—that of dipping the cut seed pieces in the suspension which was used at four concentrations (full strength, 1:10, 1:100 and 1:1000) and for four periods of time (1, 10, 30 and 60 minutes). (Exp. 2).—The bacterial suspension was diluted 1:2, 1:4, 1:8, 1:16, 1:32, 1:64, 1:128, 1:256, 1:512 and 1:1024. Here also, two methods of inoculation were used,—that of eye inoculation and that of soaking the seed pieces in the suspension for a period of 60 minutes.

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Experimental Results

In 1945 the plants were inspected for ring-rot symptoms at three dates,—the 14th and 19th of August, and the 4th of September. The following table shows the per cent of ring rot resulting at each of these dates from the suspension-concentrations used in the two methods of inoculation.

Table 1—*Ring rot resulting at three dates of inspection from bacterial suspensions, used at different concentrations and in two methods of inoculation.*

Concentration Bacterial Susp	Per cent Ring Rot					
	August 14		August 19		September 4	
	Susp.*	Eye**	Susp.	Eye	Susp.	Eye
Full strength	45	100	60	100	70	100
1 : 2	30	100	40	100	60	100
1 : 4	44	63	44	63	56	74
1 : 8	45	90	55	100	55	100
1 :16	5	80	25	90	45	90
Average	34	87	45	91	57	93

*Seed pieces left ½ minute in bacterial suspension.
**Bacterial suspension dropped on eye and stabbed in with needle.

Table 1 shows that eye-inoculation gave higher average percentages of ring rot than did the dipping of cut seed in a bacterial suspension for ½ minute. Also, on the 14th of August, 86 days after planting, ring-rot symptoms had developed earlier with eye-inoculation than with the suspension. The effect in resulting ring rot of diluting the bacterial suspension (up to 1:16) was slight when eye-inoculated, but the effect was considerably greater when the cut tubers were inoculated by placing them in the suspension.

Smears were made from stems taken from each hill in each series. These were stained and examined for the presence of ring-rot bacteria. Each was given a number (1-5) to indicate the relative number of bacteria found on the slide.

The following table shows this relationship:

TABLE 2.—*Relative number of bacteria found on slides at the different dilutions used and with each method of inoculation.*

Dilution of Bacterial Suspension	Method of Inoculation	
	In Suspension (½min)	Eye Inoculated
Full strength*	2 8**	3.0
1 : 2	3 1	3.2
1 : 4	2 9	3.8
1 : 8	2 5	3.3
1 :16	2 0	3 1

*3¼ grams of bacterial ooze to 100 cc. water.
**Average relative number of bacteria, —1 = slight, 5 = maximum found.

Table 2 shows relatively more bacteria on the slides made from plants originating from seed pieces previously eye-inoculated than from those dipped in bacterial suspensions. Moreover, the relative number of bacteria in those plants, eye-inoculated, did not vary greatly as a result of the different dilutions used as inoculum; however, the number was reduced considerably as the bacterial suspension was diluted previous to inoculation.

In 1946 the experiments were inspected for ring rot at four dates,—the 9th and 17th of August and the 1st and 9th of September. The results are tabulated for each date,—showing the amount of ring rot resulting from the two methods of inoculation and from various dilutions of the inoculum.

In general, there was slightly more ring rot resulting from the eye inoculation than from soaking seed pieces in the suspension. The differences in ring rot between these two methods were greatest in the first inspection but gradually became less in the later inspections.

In the second experiment the effect of the length of period in the suspension as well as the dilutions of the bacterial suspensions was studied The results are based upon the amount of ring rot found in the plants. An index figure was calculated for ring rot, using 1 for beginning symptoms and 5 for most severe plant symptoms.

Table 4 shows that the more concentrated suspensions produced earlier symptoms as well as the most ring rot. In fact, in this experiment, which was planted one week later than the one previously described, no ring-rot symptoms were manifest from the inoculum having dilutions of 1:100 and 1:1000. In general, more ring rot resulted with

TABLE 3.—*Ring-rot found at four dates of inspection resulting from two methods of inoculation and eleven concentrations of inoculum (plant symptoms).*

Bacterial Suspension	Per cent Ring Rot							
	August 9 Inoculation		August 17 Inoculation		September 1 Inoculation		September 9 Inoculation	
	Susp.*	Eye**	Susp.	Eye	Susp.	Eye	Susp.	Eye
Full strength	84	94	89	100	95	100	100	100
1 : 2	89	89	100	100	100	100	100	100
1 : 4	65	80	80	95	100	95	100	95
1 : 8	55	65	80	100	90	100	90	100
1 : 16	47	75	74	95	90	95	90	95
1 : 32	30	100	60	100	85	100	100	100
1 : 64	63	90	84	95	95	95	100	95
1 : 128	16	42	26	79	53	100	63	100
1 . 256	5	53	26	74	78	100	89	100
1 : 512	10	20	25	45	35	70	40	85
1 .1024	5	0	5	5	5	10	20	20
Average	43	64	59	81	75	85	81	90

*Seed pieces left 60 minutes in bacterial suspension.
**Suspension dropped on eye and stabbed in with needle.

TABLE 4.—*The effect of length of treatment of seed pieces as well as dilution of the bacterial suspension upon the resulting ring-rot.*

Strength of Suspension	Length of Treat-ment	Per cent Ring Rot				Sever-ity Index Ring Rot
		Aug. 9	Aug. 17	Sept. 1	Sept 9	
Full strength*	1 Min.	40	60	75	75	3.1
" "	10 Min.	21	58	89	89	3 7
" "	30 Min	32	47	63	63	2.6
" "	60 Min.	35	75	100	100	4 3
Average		32	60	82	82	3.4
1 : 10 Dilution	1 Min.	0	18	53	53	1 7
" " "	10 Min.	10	40	60	65	2.5
" " "	30 Min.	5	10	30	40	1 0
" " "	60 Min.	15	55	95	95	3 5
Average		8	31	60	63	2 2

1 · 100 Dilution. No ring-rot symptoms found at this dilution.
1 :1000 Dilution. No ring-rot symptoms found at this dilution.

the longer inoculation period, with the exception of the 30-minute period.

SUMMARY

Experiments were started in 1945 and continued in 1946 to determine the effect of different quantities of inoculum on the subsequent development of ring-rot symptoms in the plant.

When seed pieces were eye-inoculated the per cent of ring rot was similar to that obtained by soaking the seed pieces for 60-minute periods in a bacterial suspension but more than that obtained by soaking the seed pieces for periods of ½, 1, 10 or 30 minutes.

In 1945 the dilution of the bacterial suspension (1:16) had only slight effect in resulting plant symptoms when the seed pieces were eye-inoculated. However, when soaked in the suspension (½ minute) there was less ring rot in the plants and also relatively less bacteria as a result of the greater dilution of the inoculum.

In 1946, when the bacterial suspension was diluted to approximately 1:1000, there was only a small amount of ring rot detected in the plants, although the difference in late season was slight at approximately 1:500 dilution or less. As an average for all tests, eye inoculation resulted in an earlier development of ring-rot symptoms than soaking in the bacterial suspension, with the difference gradually becoming less as the season progressed. In another experiment,—as shown in table 4,—planted one week later, no ring rot was detected in the plants

*Seven grams of ring-rot ooze to 250 cc. water.

grown from seed pieces inoculated with the suspension diluted 1:100 and 1:1000. However, this material has been stained and will be examined microscopically as time permits. In addition, tubers have been saved from each of these hills to plant next season for further observation. This study will be continued until adequate information is obtained on the effect of various degrees of inoculum and the period of time necessary to produce plant symptoms.

STEM STREAK NECROSIS OF POTATOES IN RELATION TO SOIL ACIDITY[1]

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During the course of a greenhouse fertilizer and lime experiment with potatoes on a very acid Antigo loam soil, there appeared a severe stem streak necrosis where the soil had been treated with sulfates and chlorides but not when the soil was limed. The necrosis developed also on the untreated acid soil (pH 4 7), but was more severe when fertilizer salts, calcium sulfate or magnesium sulfate were applied. Addition of these salts caused the pH of the soil to drop to 4.5. It was found later that this stem streak necrosis was rather common in northern Wisconsin, especially on fields where potatoes had been grown for a considerable time.

Stem streak necrosis symptoms similar to those here reported were described by Dippenaar (1),[3] who in 1933, while working on scab control in Wisconsin, found that when soils were treated with sulfuric acid so that the resulting pH was lower than 5.1, stem streak necrosis occurred.

Fried and Peech (2) compared gypsum and lime on acid soils for barley, alfalfa, and perennial ryegrass and found that gypsum had a deleterious effect on all plants even though the soils used were low in calcium They considered the possibility of toxic effects of soluble manganese, iron, and aluminum. Funchess (3) suggested that the factor in acid soils detrimental to plant growth might be excess soluble manganese. Jacobson and Swanback (4) found that as little as one part

[1]Contribution from the Department of Soils, University of Wisconsin, Madison 6, Wis. Published with the permission of the director of the Wisconsin Agricultural Experiment Station.
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per million of manganese in solution culture was harmful to the growth of tobacco.

Because the pH of many of the soils in the potato-growing area of Wisconsin is below 5.0, studies were initiated to determine, if possible, the soil factors which cause this stem streak necrosis. Among the possibilities investigated were influence of a deficiency of calcium and magnesium, strong acidity, and excess of soluble aluminum and manganese.

Nature of Stem Streak Necrosis

Stem streak necrosis appears as dark brown-pitted areas on the outside of stems near the base. They appear early at the base of the petioles and appear as long streaked flecks of brown on the petioles themselves. The streaks on the stems are quite long and narrow and extend into the center of the stem. A pale yellow green chlorosis also appears in the leaves in areas between the veins, whereas the veins themselves remain green. As the symptoms progress, the chlorosis becomes more severe and finally the leaves dry up and fall off. Quite often in severe cases small brown necrotic areas, irregular in shape, appear between the veins near the midrib on the leaflets. The affected parts become extremely brittle so that the peitoles will drop off with a slight touch. As the conditions become more severe, the streak progresses upward, and finally the terminal bud dies and a stunted plant results which dies prematurely,—and consequently the yield of tubers is lowered.

Greenhouse Experiments with Antigo Loam

Antigo loam was treated with various fertilizer and lime materials as indicated in table 1. The soil was first thoroughly mixed and then portioned into one gallon jars. The fertilizer and lime materials were then thoroughly mixed with the soil. Triumph potatoes were then planted.

Stem streak necrosis appeared first on plants receivng 3-12-12 fertilizer plus calcium and magnesium sulfates; next, on those receiving only 3-12-12 fertilizer; and lastly, on those growing on the untreated soil. Plants receiving lime and 3-12-12 fertilizer were normal and healthy as can be seen in figure 1. Plants affected with stem streak necrosis died prematurely, and this lowered the yield considerably as indicated by the data in table 1.

Although the results of this experiment indicate that stem streak necrosis is not caused by a deficiency of calcium or magnesium, a further test was conducted in which the deficiency symptoms of all of the nutrient elements obtained from the soil were produced. In no case

TABLE 1.—*Yield of Triumph potatoes grown in greenhouse on Antigo loam having a pH of 4.7 which was changed by addition of lime and fertilizer as indicated.*

Yield of Tubers per Jar

Soil Treatment (Acre Basis)	Soil pH at End of Experiment	Total Weight Grams	Number	Severity of Stem Streak Necrosis
Untreated	4.7	89	9	Severe Symptoms developed in 37 days
1000 pounds 3-12-12	4.5	37	3	Very severe Symptoms developed in 30 days
1000 pounds 3-12-12+ 2000 pounds lime (1)	5.7	136	7	No necrosis
1000 pounds 3-12-12+ calcium and magnesium sulfates (2)	4 5	40	3	Very severe Symptoms developed in 28 days.

(1) The lime used was finely ground dolomite; 97.8 per cent passed a 100 mesh screen and 72 per cent passed a 300 mesh screen, it contained 41 0 per cent magnesium carbonate and 50 6 per cent calcium carbonate

(2) The amounts of calcium and magnesium added were equal to the amounts added to the other pots as limestone.

did deficiency symptoms similar to stem streak necrosis appear Even though a deficiency of calcium or magnesium in potatoes produces chlorosis in the leaves, it does not produce a stem streaking and flecking.

SOLUTION CULTURE EXPERIMENTS WITH ALUMINUM

The effect of soluble aluminum on potatoes was studied in nutrient solution cultures at various pH levels. Phosphorus was supplied as mono-basic potassium phosphate and was kept separate from the rest of the solution containing the soluble aluminum by means of a divided container and root system in order to prevent precipitation of the aluminum as phosphate. The pH of the nutrient solution was varied from 4.0 to 8.0. Excess aluminum was added in the form of aluminum sulfate, so that the soluble alumina (Al_2O_3) content was as follows:

pH Value	Al_2O_3 in Solution Parts per Million
4.05	134 0
4 25	69 7
4.50	23 0
5 10	3 0
5.70	0.5
6.80	3.0
8.10	9.4

FIGURE 1 Triumph potatoes grown on Antigo loam showing stem streak necrosis at the right.

3B—Normal plant. Treated with 1000 pounds 3-12-12+2000 pounds finely ground limestone per acre. Resulting pH 5.7.

4B—Severe stem streak necrosis. Treated with 1000 pounds 3-12-12+ calcium and magnesium sulfates equivalent to the calcium and magnesium supplied by the lime in 3B Resulting pH 4.5.

In no case did symptoms of stem streak necrosis appear, although the plants were stunted at the lower pH levels where a high content of soluble aluminum existed. The experiment gave no evidence that soluble aluminum causes stem streak necrosis.

In the parallel experiment where aluminum was excluded and only the effect of hydrogen ion concentration studied, no marked deleterious effects were observed until the pH of the solution dropped below 4.0, or rose above 7.5. No symptoms of stem streak necrosis developed.

SOLUTION CULTURE EXPERIMENT WITH MANGANESE

The possibility of excess manganese causing stem streak necrosis was next investigated. Potatoes, supported on a wire screen, were grown in complete nutrient solutions contained in one gallon jars. The manganese was added as manganese chloride at the rates of 1, 5, 10, 25, 50, 100, and 200 parts per million of solution. Air was bubbled continuously through the solutions, and they were changed completely, as

often as necessary, in order to maintain the proper concentration of nutrients.

The potatoes were sprouted in sand, and when the plants were about four inches high they were transplanted to the screens, which were covered with glass wool.

After nine days, the plants receiving 200 parts per million of manganese developed stem streak necrosis identical with that which developed in soil cultures in the earlier experiment. After two more days, the potatoes in solutions containing 100 parts per million of manganese also showed symptoms of stem streak necrosis. The plants growing in the solution containing 200 parts per million of manganese

FIGURE 2 Irish cobbler potatoes grown in complete nutrient solution containing 200 parts per million of manganese Plants show stem streak necrosis identical to that of plants grown on very acid soils.

are shown in figure 2. As can be seen by comparison with figure 1, the necrosis symptoms are alike.

This experiment is still in progress, and the details, together with plant analyses will be reported later. The evidence appears conclusive that excess of soluble manganese is the cause of stem streak necrosis of potatoes.

The manganese of soil becomes much more soluble as the soil becomes more acid. The addition of lime rapidly decreases this solubility by lowering the solvent power of the soil solution, and causing some of the manganese to be changed from the more soluble manganous state to the rather insoluble manganese dioxide

Summary

During the course of a greenhouse fertilizer and lime experiment with potatoes on a very acid Antigo loam soil there appeared a severe stem streak necrosis where the soil had been treated with sulfates and chlorides but not when the soil was limed. It was found that this necrosis developed quite often in the field when the soils were more acid than pH 5.1.

Stem streak necrosis appears as dark brown pitted areas on the outside of stems near the base. They appear early at the base of the petioles and appear as long streaked flecks of brown on the petioles themselves. The streaks on the stems are quite long and narrow and extend into the center of the stem. A pale yellow green chlorosis also appears in the leaves in areas between the veins, while the veins themselves remain green. As the symptoms progress, the chlorosis becomes more severe and finally the leaves dry up and fall off. Quite often in severe cases small brown necrotic areas, irregular in shape, appear between the veins near the midrib on the leaflets. The affected parts become extremely brittle so that the petioles will drop off with a slight touch. Finally the terminal bud died followed by premature death of the plant and consequent lowered yield.

Greenhouse tests in complete nutrient solutions showed that neither hydrogen ion concentration, soluble aluminum, calcium deficiency or magnesium deficiency were the cause of stem streak necrosis. Further tests with excess soluble manganese showed that in complete nutrient solutions containing 100 and 200 parts per million of soluble manganese, stem streak necrosis was produced which was exactly like that found in potato plants grown on soil. It was therefore concluded that excess soluble manganese is the cause of stem streak necrosis found in potatoes grown on acid soils.

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THE USE OF NEW INSECTICIDES IN THE CONTROL OF POTATO INSECTS

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Each year new materials are developed for control of insects hoping for a "shot gun specific," effective for the control of all insects under every condition. During the war many new insecticides were developed which *almost* reached this expectation as far as potato insects are concerned.

For the past three years at the Lake City Experiment Station, the use of DDT on potatoes has given us unprecedented control of the Colorado potato beetles, flea beetles, and potato leafhopper. At the strengths used, however, six-spotted leafhoppers, tarnished plant bugs, and spittle insects were not so readily controlled. Fairly good control of aphids was obtained in 1945 but these insects were practically absent in 1946.

During 1946 at the Lake City Experiment Station several strengths of DDT, combination of DDT with other materials, and new materials were used both as sprays and dusts on potatoes.

The sprays were applied at the rate of 150 gallons per acre at ten day intervals from the 27th of June to the 29th of August inclusive, and the dusts were applied at the same intervals and dates at the rate of 50 pounds to the acre.

Planting of the variety Menominee on May 16 was used in all plots. These plots were irrigated five times during the season by a rotary sprinkler system.

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Insects were very abundant early in the season. The insects counts were made by taking five complete sweeps on the two inside rows of each plot, one, five, and nine days after applications. The counts showed in most cases that the materials used gave very low insect populations up to five days and were the highest at nine days.

Results of Insect Control

Tables 1 and 2 give the results of the insect counts made at one, five, and nine days after application.

For potato leafhopper control in the spray plots, Bordeax 8-12-100+¾ lbs. DDT, Tribasic + DDT 4-¾-100, Zinc nitrodithioacetate + DDT, 2-1-100, and Tribasic + Hercules 3956 (chlorinated terpene hydrocarbon) 4-¾-100, gave the best results whereas no consistency of control of the six-spotted leafhoppers were observed in any of the plots.

Spittle bugs, tarnished plant bugs as indicated in table 1 were controlled with most of the materials used at least up to five days with a slight increase in population after five days in most cases. Flea beetles were not a problem early in the season but late in August were beginning to appear in numbers On the 31st of August a killing frost prevented further counts.

In table 2 the results of the dust plots showed the best control of the potato leafhopper by the use of freshly mixed mono-hydrated copper sulfate + lime + 3 per cent DDT; Tribasic + DDT 1 per cent, 3 and 5 per cent DDT impregnated Yellw cuprocide, and Basicop + DDT 3 per cent, up to 5 days after application. The control of the six spotted leafhopper, however, seemed varied, but from all indications control was better five days after applications of the dusts.

Spittle bugs, tarnished plant bugs, and flea beetles were controlled in most instances over the nine day intervals by most of the dusts used. As compared with results from the same insecticides on spray plots, the applications of dusts appeared to give better control of the above insects this year.

Summary

In spraying and dusting experiments carried on at the Lake City, Michigan Experiment Station, potato leafhoppers, 6-spotted leafhoppers, spittle insects, and tarnished plant bugs were abundant throughout the growing season of 1946.

None of the materials tested gave better insect control than DDT alone or this insecticide in combination with Bordeaux or the fixed coppers. Using the same strength materials, the dusts appeared to give

TABLE 1.—*Insect control on potato spray plots 1946—Lake City Experiment Station.*

MATERIALS	Potato Leafhoppers			Six-Spotted Leafhoppers			Spittle Bugs			Tarnished Plant Bugs			Flea Beetles			Bu. Per Acre Total Yield
	*1	5	9	1	5	9	1	5	9	1	5	9	1	5	9	
Bordeaux + DDT (8-12-100 + ¾ lb.)	0	1	10	4	1	5	3	2	1	0	1	1	0	0	0	241.7
Bordeaux + DDT (8-4-100 + ¾ lb.)	0	1	17	1	2	4	1	2	3	0	2	3	0	0	0	212.3
Tribasic + DDT (4-½-100)	0	1	17	4	2	2	3	3	1	4	1	4	0	0	4	212.1
Tribasic + DDT (4-¼-100)	0	0	22	6	0	11	5	2	9	2	2	7	0	0	7	219.7
Tribasic + DDT (4-¾-100)	1	1	10	3	1	2	1	2	2	2	0	1	1	0	2	226.4
Tribasic + Sul. + DDT (4-4-¼-100)	0	1	27	5	4	8	5	0	6	0	1	11	0	2	4	235.5
Zinc nitrodithioacetate + DDT (2-1-100)	0	0	8	1	4	5	2	1	3	0	1	2	0	0	2	227.5
Bordeaux + B H.C. (8-4-2-100)	0	2	18	5	6	4	1	0	6	0	1	4	0	1	0	203.2
Tribasic + B.H C. (4-2-100)	2	1	32	5	9	2	4	2	9	0	0	6	2	1	3	180.6
Zinc Nitrodithioacetate + B.H.C (2-2-100)	0	1	15	7	8	6	1	2	3	1	1	5	0	0	0	199.0
Copper nitrodithioacetate + B.H. C. (2-2-100)	0	3	26	9	14	3	1	4	3	2	1	4	0	1	4	196.0
Tribasic + Diethyl (4-1 pt -100)	0	0	29	3	7	7	2	3	6	1	1	2	0	0	1	241.8
Tribasic + Omilite + DDT (2-1 qt.-¾-100)	0	0	34	0	6	11	3	3	6	0	0	2	0	1	4	231.7
Tribasic + Hercules 3956 (4-¾-100)	1	0	8	6	6	1	3	1	3	2	1	0	1	0	4	322.5
DDT alone (¾-100)	0	1	33	5	6	2	3	0	4	2	2	3	0	1	0	226.9
Dithane + Zn + L + DDT (2 qts -1-½-¾-100)	0	1	24	2	5	6	1	4	5	7	1	2	0	0	4	275.5
F-48 + Diethyl alternating (4-1 pt.-100)	1	2	23	8	13	10	2	4	7	3	1	6	1	3	5	325.4

*Counts made 1-5-9-days after application

TABLE 2.—*Insect control on potato dust plots 1946—Lake City Experiment Station.*

MATERIALS	Potato Leafhoppers			Six-spotted Leafhoppers			Spittle Bugs			Tarnished Plant Bugs			Flea Beetles			Bu. Per Acre Total Yield.
	*1	5	9	1	5	9	1	5	9	1	5	9	1	5	9	
Mono. Copper + Lime + DDT 3 per cent	0	0	3	12	9	0	0	1	0	0	6	1	0	0	0	356 1
Copper A + P.C.H 10 per cent	0	0	11	6	10	7	0	3	0	1	2	5	1	3	2	357.9
Tribasic + DDT 3 per cent	0	0	13	11	3	7	0	2	1	2	3	9	0	1	2	361.1
Tribasic + DDT 2 per cent	0	0	11	2	2	6	2	1	1	1	3	7	0	0	1	307 1
Tribasic + DDT 1 per cent	0	0	6	4	1	1	2	0	0	0	2	5	0	0	1	343 6
Tribasic + DDT ½ per cent	0	0	14	8	0	4	1	2	0	0	2	3	0	1	1	316.1
Tribasic + Sul. 40 per cent + DDT 3 per cent	0	1	20	5	2	5	1	1	0	0	2	3	0	0	2	353 1
Y. Cuprocide + DDT (Impreg.) 3 per cent	0	0	6	2	1	-6	0	2	3	0	4	1	0	0	1	376.1
Y. Cuprocide + DDT (Impreg.) 5 per cent	0	0	5	15	6	2	2	2	1	0	1	3	2	0	0	380.4
Tribasic + B.H.C. 10 per cent	0	0	16	24	2	3	3	2	0	0	2	4	0	1	3	364.5
Basicop + DDT 3 per cent	0	0	4	9	1	3	2	2	3	1	0	2	0	1	0	357.6
DDT alone 3 per cent	0	0	18	13	3	5	1	3	0	3	3	2	0	0	0	369.0

*Counts made 1-5 and 9 days after application.

somewhat better control than the sprays on spittle insects, tarnished plant bug, and flea beetles.

Because of the fact that the spray and dust plots were located on different types of soils and with different levels of fertility, no comparison can be made of the yields between the series of plots.

SECTIONAL NOTES

ALABAMA

Next Monday, the 5th of May, our growers will start harvesting their Irish potato crop in earnest, weather permitting. Our present estimates give us only about a 60 per cent of normal crop this year. Indications are that Baldwin County will ship about 2,500 cars,—300 bags each. Our total shipments for the Commercial crop in this section will be less than 3,500 cars if present estimates pan out. This means that our growers will probably come out but profits will not be handsome.

Late Blight was first found on the 17th of April and after a few days of development has spread to most of the earliest sections of our deal. Growers discouraged because of weather conditions which prohibited dust and spray programs to be carried out, seemed to become careless in Blight control after the break in the rains. This probably has contributed to the fast spread of the blight. The writer thinks that Late Blight probably will cost us more this year than last despite the fact that it was found 23 days later this year than last. The Sebago variety will probably be less damaged than the Triumph as Blight does not seem to keep them from sizing up to market size.

Most of our growers have complied with the support price revisions and will be in a position to receive $2.20 per hundred for their U. S. No. 1 potatoes delivered at the sheds should the market go that low. With the short crop, there is a feeling that our potatoes should move above this figure. We can expect a higher per cent of B size than average with the growers support at $1.20 per hundred.

Certification Officials from our seed-producing states were able to secure good readings on the more than 170 seed source samples and some 17,000 index tubers planted at the Gulf Coast Substation Fairhope, Alabama. There are indications that there was little spread of virus diseases in most of the seed-producing states. It is not the exception to find sample after sample with a clear reading. At present a special ring-rot reading will be made. (May 21).—FRANK E. GARRETT.

CALIFORNIA

Our peak shipment to date by rail is 270 cars, all of which are being harvested in the Edison early section. The entire potato producing area, however, is now rapidly getting in condition to start harvest.

We expect to harvest this year in the floor of the valley approximately 48,000 acres instead of roughly 61,000 acres in 1946. The price is gradually declining and may be down to $2.50 per hundred by the time this letter reaches you. The quality of the crop to date is above average. The yields are above average. There was little compliance with the goals in the early Edison district as compared to the rest of the county, primarily because the early producers felt that their crop would be marketed well above ceiling and did not support the government program. In the remainder of the producing areas, however, a very high percentage of the growers planted within their goal as established by the Department of Agriculture.

There is a movement afoot at the time in Kern County to organize and establish a California Marketing Agreement. The first public hearing was held yesterday. No one is in a position to know what the final vote of the growers will be. This should be known within approximately 30 days. (April 30).—M. A. LINDSAY.

COLORADO

The potato marketing season is rapidly reaching the end in Colorado. The San Luis Valley completed moving the bulk of its Red McClures several weeks ago. Weld county is still shipping potatoes but is rapidly cleaning up as planting time approaches

The indications are that Colorado growers will, in general, stay within their allotted acreages. Some few growers will exceed their individual allotments but the state acreage will probably not exceed the state allotment of 83,300 acres. The early planting will begin about the 15th of May continuing on into June with some certified seed plantings as late as the first of July. The certified seed market has been very active for the past month, particularly for Bliss Triumph and Red McClure. The Irish Cobbler market has been dull all season for both commercials and certified seed.

In Weld county the moisture situation is the best in years with several light snows and rains in April providing ample moisture for a good seed bed. In the San Luis Valley, it has been quite dry but with a better water supply than last year (May 1).—CECIL W. FRUTCHEY.

INDIANA

Our spring is late and very few plantings have been made. If other states are the same, there will be a great need to hold on to the available stock of last year's crop. This year's plantings and the early harvest are on our markets now. The quality is good and the demand strong.

We will continue to carry on our date of planting experiments, weather permitting, and we may be a week late in our first planting.

Good seed is very scarce here in Indiana and, as usual, Katahdin, Irish Cobbler, Sebago and Sequoia are in greatest demand. (April 28).
—W. B. WARD.

MAINE

Maine shipped approximately 1,000 more cars on the 7th of May then they shipped by the 15th of June last year. Guesses indicate that Maine will ship between 57,000 to 58,000 cars in all.

The last week has been cold and rainy and indications are that Maine will be at least one week to two weeks behind in their planting.

The volume of certified seed sold now totals 8,229 cars compared with last year's 7,702 cars. On the basis of the Florida test, Maine is planting the best seed in its history. Seed sales among the farmers in the county appear higher also.

Maine had too many Irish Cobblers last year and it seems apparent there is a decided drift away from that variety this year. Very few Aroostook farmers are treating seed before planting.

Farmers have received their acreage allotment from the Triple A. It is estimated that over 90 per cent of the farmers will participate.

Commissioner A. K. Gardner has ruled that it will not be necessary to isolate the Chippewa variety 250 feet for certification purposes. There is a requirement that Chippewas must be tested in Florida before final certification. Last year several fields that were rejected because of distance had as good a reading as some Chippewas that passed certification. Because this has happened for the past two years, Commissioner Gardner believes that if Chippewas pass the Florida test they have met certification requirements. (May 7).—VERNE C. BEVERLY.

MISSOURI

Continual rain and generally cool temperatures throughout March and April have given the Missouri potato crop a slow start. Planting got underway during the third week in March and continued, at interrupted intervals, throughout all the month of April. Reports indicate

that somewhere between 85 per cent and 95 per cent of the intended acreage finally got planted. The 1947 acreage is estimated slightly smaller than that of 1946.

The first plantings of potatoes are coming up slowly and irregularly because of the cold wet soil and very little sunshine during April. There was some evidence of seed piece decay in the early plantings. Currently, this is not thought to be too serious.

All fields were fertilized and the rates were quite variable, ranging from 400 pounds to 1,300 pounds per acre. Many growers used 10-6-4, but owing to fertilizer shortages, some other formulas were also used. Most growers side dressed with 10-6-4, but some used 8-8-8 whereas others used ammonium nitrate.

Irish Cobbler was the leading variety, with Warba and Triumph next in rank. (May 6).—ALLAN PURDY.

NEBRASKA

At this time, Nebraska potato farmers are in the process of getting land prepared for the planting of the late crop, which will begin about the 10th of June. This consists of, in some cases, discing the land, to prevent early weed growth, particularly on the dry land territories. Under irrigation, where most growers follow the practice of growing alfalfa or sweet clover, preceding the potato crop, the land will be plowed within the next week or two, then thoroughly worked and finally "floated" prior to the planting operation. Since we have had a cool spring, the growth of alfalfa and sweet clover has been slow, and is not up to what is considered normal for this time of the year. Most growers like to have somewhere between one and two feet of green matter to turn under, however, that may not be the case this season.

Quite a few growers are dipping their potatoes with hot formaldehyde for the purpose of controlling scab and retarding sprout growth prior to planting. This dipping process is also recommended for control of any contamination that may be on the surface of the potato or the sacks. This applies particularly to Ring Rot, where seed potatoes have been transferred from one storage to another. It is of course, of no value to control Ring Rot infection within the tuber.

The potato program for the late crop contemplates an allotment system, and growers are being signed up under this program. The late crop allotment is somewhat in excess of last year's acreage because the over-all plantings have been down in this state for some time. The plantings on the early crop of central and eastern Nebraska were completed just a short while ago, considerably later than usual. The late, cold

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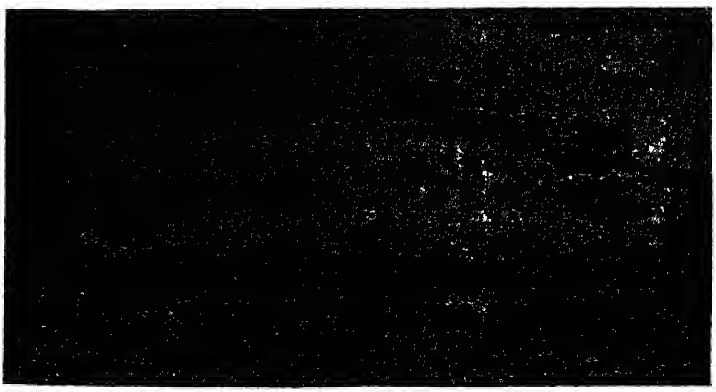

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spring, combined with excessive rainfall during March and early April, delayed plantings beyond the usual date, which is about the 1st to 10th of April. Conditions otherwise are favorable, so the crop should advance, and with warm weather recently, this should make up for lost time. The acreage planted in the early territories, is considered as below normal. The principal variety is Red Warba, having crowded out Cobblers over the past few years Some Bliss Triumphs are planted, and of course, there is still a certain amount of Irish Cobblers, but they are distinctly in the minority.

Certified potato growers were recently informed of the results on their southern test plat plantings. In most cases, these results were favorable. As a matter of fact, the quality of the seed to be planted in the coming season is considered improved over that planted a year ago. The neglect of war years was very apparent in test plantings made in the spring of 1946 in the southern states. As a result, a great deal of effort was spent by certification officials and growers themselves in improving the crop. This, of course, was done by discarding poorer, low quality seed stocks, substituting better seed, and by roguing of seed plots. For the first time in many years, thorough roguing was possible, and the results were apparent in the testing program carried on during the winter. This situation is undoubtedly duplicated in many other territories. (May 6) —MARX KOEHNKE.

NEW YORK

The table stock market advanced strong with the balance of local supplies going at about $3.50 cwt. f.o.b. It is only the 1st of May and there are no more potatoes available than would be expected in a normal year.

Seed potatoes are about cleaned up also, at least three weeks ahead of average. The demand has been good during the last few weeks but the volume was below normal indicating that the acreage intentions are below average. In fact the State Crop Report indicates about 12 per cent decrease from last year.

Our New York growers are going into Tetons quite extensively because this variety has been found to be not only resistant to ring rot and also certain virus diseases, besides being a good yielder of well-shaped tubers, Teton seems to keep pretty well and recent tests indicate that they are superior when it comes to making potato chips. About 200 acres will be entered for certification this year.

Much interest is being shown in marketing agreements and several National and state wide meetings have been held at which this subject

was the chief one discussed Before making any recommendations every one wants to learn all he can about agreements and how they will fit New York state conditions. It is expected that something will sugar-off in the near future. (May 2).—H. J. EVANS.

RHODE ISLAND

This has been a very cool, wet spring, and farmers are way behind with their planting. Many growers have been forced to hold cut seed so long that it has spotted rather badly. Stem-end browing has shown up in the seed this year more than for several years past.

As a whole, growers are sticking closely to their allotments. If the weather doesn't improve soon, some growers will not even plant their entire allotments.

The new Rhode Island Potato Growers' Association is right on its toes. The executive committee has held several meetings and made plans which should benefit the growers. (May 7)—AVERY E. RICH

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THE LONGEVITY OF *CORYNEBACTERIUM SEPEDONICUM* ON POTATO BAGS WHEN PLACED UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

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Tests were begun in 1942 at the Wyoming Agricultural Experiment Station to study the problem of the persistence of the ring-rot bacterium, *Corynebacterium sepedonicum,* on potato bags under various environmental conditions. More recently, this study has included tests to determine if these bacteria can be killed by exposing the contaminated bags to sunlight for different lengths of exposure.

EXPERIMENTAL METHODS

In most cases, tubers infected with both ring rot and soft rot have been used as sources of inoculum, such as would occur commonly in nature. This inoculum has been placed either in the burlap bags and vigorously shaken around in them or rubbed on the sacks to insure heavy contamination. In the latter cases, the areas contaminated have been outlined with a black marking pencil so that they could be located accurately later on. The bags were rolled and tied in small bundles and placed either inside or outside of the storage cellar. When ready to test, the contaminated burlap was cut from the bag and placed in a small quantity of water to release the bacteria. Freshly-cut seed pieces were then placed in this solution for periods of one minute or more The seed pieces were then planted in field plots. Readings were made several times during the growing season for the presence of ring rot.

During the spring of 1946, 100-pound burlap bags were contaminated by rubbing small areas of the bags (6″ x 6″) with tubers heavily infected with ring rot These bags were then hung up singly on the south side of a building so that they would be exposed to direct sunlight during the day. The bags were exposed for 10, 20, 30 and 40-day periods before testing them for the presence of viable bacteria. A similar test was made with bags stored in the greenhouse away from direct sunlight for the same periods of time. At the termination of the testing period, the contaminated portions of the sacks were laid on a sterile surface and rubbed with freshly-cut seed pieces of healthy Bliss Triumph potatoes These were planted in field plots in 10-hill rows, replicated four times.

Tests conducted during 1942, 1943 and 1946, indicated that ring rot bacteria may be carried on potato bags stored either inside or outside of potato storage cellars during the period from November to June. Results of this nature are shown in table 1.

TABLE 1 —*The survival of ring-rot bacteria on potato bags inside and outside of cellars (November to June)*

	Positive Evidence as Carriers of Ring Rot*		
Kind of Bags and Location	1942	1943	1946
Burlap bags in cellar	+	+	+
Burlap bags outside of cellar		+	+
Canvas bags in cellar			+
Canvas bags outside of cellar			+

*Most of these tests gave some negative evidence in certain replications

The sacks listed in table 1 were rolled up in bundles and not spread out as they were in table 2. In the latter case, the bags were hung singly with full exposure to the sun. The extent of the carry-over of ring-rot bacteria is shown in table 2.

TABLE 2—*The effect of sunlight on the survival of ring-rot bacteria on burlap bags.*

	Duration of Test and Resulting Ring Rot (4 Replications)			
Location of Burlap Bags	10 Days	20 Days	30 Days	40 Days
	Per cent	Per cent	Per cent	Per cent
South side building (outside)	70	49	20	10
Inside building (attic)	95	95	66	70

The results show a decided reduction in ring rot with increased length of exposures to weather conditions. However, a 40-day period was not sufficient to eliminate the ring-rot bacteria completely from the burlap bags. The test shows that the bacteria survived relatively well on bags inside, away from the sunlight

Summary

It is generally thought that ring-rot bacteria may be carried on burlap bags for long periods of time, the length of which varies with the environmental conditions.

In tests conducted during 1942, 1943 and 1946, it was found that ring rot bacteria may be carried in a viable condition on burlap bags tied in bundles for periods of seven months when stored both inside and outside the cellar. However, some of the tests were negative for this period. Where 100-pound burlap bags, previously contaminated, were hung singly by the ends and the whole surface of one side exposed to the sun, the ring-rot bacteria were greatly reduced but not completely eliminated after periods of 40 days. Similar bags placed inside, away from the sun, were found to carry viable bacteria, with little reduction, for the same period of time.

ACCURACY OF THE ULTRAVIOLET LIGHT METHOD IN SELECTING POTATO TUBERS FREE OF VIRUS

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Ultraviolet light has been discussed or used by a number of investigators (1, 2, 3, 5, 6, 8, and 9) as a means of detecting the ring rot organism in potato tubers Iverson and Harrington (10) found when examining the cut ends of tubers that there were several types of fluorescence which differed in color, location, and intensity. They concluded that the use of ultraviolet light was a very satisfactory method for detecting ring rot, but noted that some types of fluorescence indicated the presence of viruses. They recommended the elimination from seed stocks of all tubers showing any type of fluorescence. Later, Iverson and Harrington (7) found in using tubers of the Netted Gem variety that the ultraviolet light method was just as effective as the gram stain method for detecting ring rot in tubers. They also were of the

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opinion that the ultraviolet light method had additional value in reducing the incidence of other "vascular" diseases. McLean and Kreutzer (11) working with the variety Bliss Triumph believed that they could identify with reasonable accuracy virus diseases and virus-disease complexes on a basis of color, location, and intensity of fluorescence.

In order to test the usefulness of ultraviolet light in detecting the presence of virus diseases in tubers grown in northern Maine, all tubers showing fluorescence in several lots of potatoes being examined for ring rot were saved. There were nine varieties: Katahdin, Sebago, Chippewa, Green Mountain, Spaulding Rose, Irish Cobbler, Sequoia, Mohawk, and Bliss Triumph. A number of tubers showing fluorescence of one type or another from each variety were planted on Aroostook Farm, Presque Isle, Maine. They were observed for any appearance of virus diseases which might be carried by the tubers. There seemed to be no correlation between fluorescing of the tuber and the appearance of a virus disease in the plants growing from these tubers.

Sufficient data were obtained to raise the question of the accuracy of determining specific virus diseases by the ultraviolet light method. A large percentage of the fluorescing tubers produced apparently healthy plants. To test further the accuracy of ultraviolet light in detecting virus diseases, it was decided to use one virus, leaf roll, in several varieties for study.

Materials and Methods

In several plots on Aroostook Farm, hills of potatoes showing definite severe leaf roll symptoms were marked, and harvested at the end of the growing season. The varieties used were Katahdin, Spaulding Rose, Sebago, Green Mountain, Irish Cobbler, Chippewa, and sixteen seedling varieties, as yet not named. Each hill was carefully dug and the tubers stored in a separate cloth bag. They were held at a temperature of about 35° F. from the 10th of October, 1945, to the 5th of February, 1946, when they were examined. Each tuber was cut across the stem end and examined immediately under an ultraviolet light lamp. Other sources of illumination were excluded. A record was made immediately after each examination. A summary of the data obtained is shown in table 1.

Discussion and Conclusions

The types of fluorescence observed were quite distinct. The heavy vascular fluorescence was markedly more intense than the light vascular fluorescence. The blue cortical area was quite distinct with an

TABLE 1.—*Type of fluorescence shown by tubers from vines having distinct leaf roll symptoms.*

Variety or Seedling	Number of Tubers Tested	Type of Fluorescence						
		None	General Yellow	Light Vascular	Heavy Vascular	Blue Net	Blue Cortex, Yellow Pith	Blue Pith, Yellow Cortex
Katahdin	86	5	0	71	0	0	5	5
Spaulding Rose	76	13	0	45	0	18	0	0
Sebago	67	4	0	27	0	1	30	5
Green Mountain	38	4	0	30	0	4	0	0
Irish Cobbler	37	4	0	27	0	3	3	0
Chippewa	45	3	25	7	0	0	7	3
Seedling No. 1	16	1	0	15	0	0	0	0
2	14	1	12	1	0	0	0	0
3	15	0	0	4	0	2	9	0
4	32	6	0	17	0	1	8	0
5	31	3	0	25	3	0	0	0
6	41	2	0	27	0	12	0	0
7	57	3	0	44	4	6	0	0
8	26	1	0	24	1	0	0	0
9	31	14	0	17	0	0	0	0
10	35	22	0	9	0	0	4	0
11	23	7	0	13	0	3	0	0
12	8	1	0	6	0	0	1	0
13	6	3	0	3	0	0	0	0
14	20	1	8	1	0	0	0	10
15	29	1	0	9	0	13	6	0
16	44	4	1	17	0	4	18	0
	777	103	46	439	8	67	91	23
Per Cent	100.0	13.2	5.6	56.5	1.0	8.8	11.7	2.9

equally distinct yellow pith area. An identically reverse condition was apparent in some tubers where the cortex was yellow and the pith section blue. In other tubers a blue-netted fluorescence appeared which was usually, but not always, associated with symptoms of net necrosis. In some varieties, notably Chippewa or seedlings with Chippewa parentage, a considerable number of the tubers showed a general bright yellow fluorescence over the freshly cut surface.

From the table it is apparent that there is no consistent correlation between fluorescence and the presence of leaf roll virus in the tuber. Some varieties, such as Katahdin, show a light vascular fluorescence in a relatively high percentage of the tubers examined. Other varieties, notably Chippewa, show a low percentage of light vascular fluorescence in tubers from vines showing distinct leaf roll symptoms. It is interesting that more than 50 per cent of all the tubers examined show a type of light vascular fluorescence. These data would support the conclusion that fluorescing tubers, particularly those with a light vascular fluorescence should be eliminated. That of other types is of less importance Although the removal of all fluorescing tubers would greatly decrease the percentage of virus-infected tubers in a seed lot, not all of the diseased tubers would be eliminated.

Summary

In an effort to determine the accuracy of ultraviolet light in detecting virus diseases of potatoes, it was found:

(1) That potato tubers fluorescing under the ultraviolet light, when planted, produced a considerable percentage of healthy plants;

(2) That tubers of twenty-two varieties taken from plants showing distinct leaf roll symptoms exhibited several types of fluorescence; and

(3) That more than 50 per cent of the tubers from leaf roll plants showed a light vascular fluorescence.

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RESULTS OF SPRAYING AND DUSTING POTATOES IN MICHIGAN IN 1946

J H MUNCIE[1] AND W. F. MOROFSKY[2]
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In the spraying and dusting experiments on potatoes at the Lake City Experiment Station in 1946, twenty-four spray and fifteen dust materials were compared with bordeaux mixture and monohydrated copper sulfate-lime dust. DDT was added to ten of the spray materials at the rate of three-fourths pound of 100 per cent DDT to each 100 gallons of spray and three pounds of pure DDT to each 100 pounds of mixed dust To the others DDT at various strengths or other organic insecticides were added. One series of plots was sprayed and one dusted with DDT at the same rate as that above but with no fungicide added as controls.

The sprays were applied at the rate of 150 gallons per acre and 400 pounds pressure at intervals of ten days during the period from the 27th of June to the 29th of August inclusive. Applications were made with a power take-off four row sprayer. Dusts were applied at the same intervals and dates at the rate of 50 pounds per acre, with an engine driven self-mixing rotary dusting machine A canvas trailer curtain 30 feet long was attached behind the dust nozzles and allowed to drag behind the machine to prevent the dust being blown away.

The plots consisted of four rows of potatoes 250 feet long and 36 inches wide. The soil of the spray plots was very sandy and varied considerably in fertility, whereas that of the dust plots was clay loam and much more homogeneous Therefore, yields are not comparable. The variety Menominee was used in all plots and planted on the 16th of May.

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[1]Research Professor of Botany and Plant Pathology.
[2]Associate Professor of Entomology.
[3]The writers are indebted to Mr A. M. Berridge, Superintendent Lake City Experiment Station for providing facilities for carrying on this project and continued interest in the investigation.
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Harvesting was done on the 7th and 8th of October, 1946. Four harvestings of 40 feet of row were made at the same intervals from the two center rows of each plot except in one plot where these rows fell on the dead furrow. In such cases the two outside rows were used. The plots were irrigated five times during the season by means of a rotary sprinkler system Two-acre inches of water were applied at each irrigation. Potato insects were abundant during the season but were readily controlled by the use of DDT or other insecticides in each application of fungicide. Late blight was not seen in any of the plots and early blight, present in only slight amounts in most plots was not a factor in yield. Blossoming of the potatoes continued until the killing frost on the 31st of August.

Results of the Lake City Experiments

Results of the spraying experiment are given in table 1. In these plots the highest yield of U S. No. 1 potatoes was obtained from the

Table 1.—*Results of spraying potatoes in 1946. Lake City Experiment Station.*

Material*	Yield in U S. No. 1[1]	Bushels per Acre Total
1. Bordeaux — 8-12-100	234.6	241.7
2. Bordeaux — 8-4-100	197 2	212 3
3 Tribasic — DDT 4-½-100	196 6	212.1
4. Tribasic — DDT 4-¼-100	207.3	219 7
5. Tribasic — DDT 4-¾-100	209 3	226 4
6. Tribasic — sulfur DDT 4-4-¼-100	226.4	235 5
7. Copper oxychloride sulfate 5-100	191 4	208 0
8 F 48 Bordow 4-100	201.1	218 2
9. Copper A compound 5-100	201 0	210 2
10 Yellow cuprocide 11/2-100	240.7	254.5
11. Tribasic—DDT 4-1-100	261 9	271 0
12 Tribasic—DDT 4-4-100**	229 7	241 8
13. Zinc nitrodithioacetate—DDT 2-1-100	219.3	287.5
14. Bordeaux BHC 8-4-2-100	191 3	203 2
15. Tribasic—BHC 4-2-100	168 9	180 6
16 Zinc nitrodithioacetate—BHC 2-2-100	183.6	199 0
17. Copper nitrodithioacetate—BHC 2-2-100	183 7	196.0
18. Phygon 1-100	215 9	226.0
19. Zerlate 2-100	238 8	247.9
20. Tribasic-Dethyl 4-1 pt.-100	232.0	241.8
21 Tribasic-Omilite 2-1 qt-100	219.6	231 7
22. Tribasic-Hercules 3946 4-¾-100	218.1	226.9
23 DDT alone ¾-100	261.3	275.5
24. Dithane-zinc sulfate-lime 2qt.-1-½-100	313 5	325.4
25. Dethyl 1 pt.-100 alternating with F48 Bordow-Dethyl 4-1 pt.-100	321.4	322 5

*Unless otherwise stated in table, ¾ pound DDT was added to each 100 gallons of spray.

**Tribasic copper sulfate and DDT ground together with no inert carrier.

[1]Least difference for significance at 5 per cent level = 57.4 bu. per acre.

plot sprayed with Dethyl alternating with F48 Bordow plus Dethyl (DDT in oil) followed by Dithane-zinc sulfate-lime-DDT. These yields are significantly better than those of any of the other plots except those sprayed with DDT alone and a tri-basic copper sulfate plus one pound of DDT ground together (plot 11). There was no significant difference in yield between any of the other materials except in plots 15, 16 and 17 although the yields of the plots sprayed with Yellow Cuprocide, Zerlate bordeaux mixture 8-12-100 plus DDT and Tribasic-Dethyl were higher than that of most of the other materials. The addition of benzene hexachloride (BHC) to bordeaux mixture or the zinc and copper salts of nitro-dithioacetate appeared to depress yields. Since insect infestation, early blight and late blight were not factors in curtailing plant growth, the increased yields from the plots sprayed with Dithane, Dethyl-F48 Bordow, tri-basic copper sulfate plus one pound of DDT and DDT alone may possibly be attributed to lack of plant injury caused by these materials or this factor plus the added effect of the DDT in the sprays.

Results of the dusting experiment are given in table 2 Due to soil variations, yields of spray and dust plots are not comparable. From these data it is seen that with the exception of plot 7 (Tribasic-DDT 2 per cent) there were no conspicuous differences in yield between any of the plots although the 5 per cent impregnated yellow cuprocide-DDT gave highest yield. It is interesting to note that the presence of a high concentration of lime, (plot 1) seemingly had no deleterious effect upon yield and

TABLE 2.—*Results of dusting potatoes in 1946. Lake City Experiment Station.*

Material*	Yield in U S No. 1[1]	Bushels per Acre Total
1. Mono. copper-lime—DDT 3 per cent	349 0	356 1
2 Copper A-PCH	346 0	357.9
3 Tribasic—DDT 3 per cent	346 6	361.1
4. Copper oxychloride sulfate—DDT 3 per cent	358 7	369.7
5 F-48 Bordow—DDT 3 per cent	340 1	351.5
6. Copper A Comp'd—DDT 3 per cent	353.5	364.6
7. Tribasic—DDT 2 per cent	297 6	307.1
8 Tribasic—DDT 1 per cent	328 8	343 6
9 Tribasic—DDT ½ per cent	303 2	316.1
10. Tribasic-Sulfur—40 per cent—DDT 3 per cent	335.6	353.1
11. Yellow cuprocide—DDT 3 per cent (impregnated)	361.3	376.1
12. Yellow cuprocide—DDT 5 per cent (impregnated)	366 6	380.4
13 Tribasic—BHC 10 per cent	352.1	364.5
14. Basicop—DDT 3 per cent	350.1	357.6
15. DDT 3 per cent alone alternating with F-48 Bordow—DDT 3 per cent	344.4	355.6
16. DDT 3 per cent alone	355.7	369.0

*All copper materials used at 7 per cent metallic strength. All dusts except numbers 1, 4. and 16 ready mixed.

[1]Least difference for significance at 5 per cent level = 56.6 bu. per acre

TABLE 3.—*Results of spraying potatoes in the Upper Peninsula, 1946.* Yield in bushels per acre U. S. No. 1.*

County	Bordeaux 8-4-100	Zerlate 2-100	Copper A 5-100	F48 Bordow 4-100	Dithane** 2qt.-100	Tribasic 4-100	COCS 5-100
Alger	232.0	230.2	210.6				
Dickinson	336.5	294.3	333.7				
Marquette	347.7	355.5	256.7				
Delta	325.0			280.0	299.0		
Houghton	338.3	344.1		320.8	350.8		355.8
Iron	229.4			243.7	153.8		
Baraga	332.7					293.5	319.3
Menominee	283.6					315.0	340.1
Schoolcraft	366.3					335.0	301.5

*DDT added to each spray at the rate of ¾ pound in 100 gallon.
**Zinc sulfate 1 lb. + ½ lb. lime added.

from close observation did not lessen the effectiveness of DDT in the control of potato insects. In the virtual absence of early and late blights the use of copper fungicides in this experiment showed neither stimulation nor depression of yields. As in the sprayed plots blossoming of plants continued until the killing frost on the 31st of August.

Results of the Upper Peninsula Experiments

Further tests of the effectiveness of various spray materials were made in growers' fields in nine counties of the Upper Peninsula. In these tests approximately one acre of potatoes was sprayed with each of two fungicides in comparison with bordeaux mixture 8-4-100. DDT was added to all sprays at the rate of three-fourths pound in each 100 gallons. Results of these tests are given in table 3, and show a considerable variation in yield of plots in the three counties where the same materials were used. In the three county trials taken together there were no significant differences in yields among materials. Early blight was not a factor in any of the fields Late blight was present as slight infection in the plots in Menominee, Schoolcraft, Marquette and Houghton counties. In these plots infection appeared to be evenly distributed during the first week of September, but further development of the disease was prevented by killing frosts during the middle of the month

Summary

In the experiments at the Lake City Experiment Station, potatoes sprayed with Dithane-zinc sulfate-lime DDT and F48-Bordow-Dethyl gave yields significanly better than those of any other materials employed. It seems possible that lack of injury to the plants from these materials or this factor and the added effect of DDT may be responsible for the increased yields. Bordeaux mixture 8-12-100, Zerlate and Yellow Cuprocide Tribasic-DDT ground together and DDT alone resulted in yields higher than those of the other materials employed, although these differences in yield were not statistically significant in every case.

The results of the dusting experiments, using fixed coppers in comparison with monohydrated copper sulfate-lime showed no significant differences in yield between these materials plus DDT or DDT alone.

Considerable variation in yield was found between plots sprayed with the same materials in different counties in the Upper Peninsula. Using the plots of identical materials in each of three counties as added replicates of materials, there was no significant difference in yield between the various sprays.

Late blight was absent in the Lake City Experiment Station tests and early blight was present in only slight amounts. In the Upper Peninsula plots late blight was present in Menominee, Schoolcraft, Marquette and Houghton counties but its development was stopped by early killing frosts before any appreciable damage resulted.

THE OVERWINTERING OF *PHYTOPHTHORA INFESTANS* (MONT.) de BARY UNDER LONG ISLAND CONDITIONS

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The disease of potatoes which is now recognized as late blight made its first appearance in the United States in 1843 near the city of Philadelphia, (Stevens 1933). In 1845 its destructive occurrence in Ireland resulted in the catastrophe we now refer to as the "Irish Famine." The rapidity with which this disease was capable of destroying a food crop as economically important as potatoes stimulated considerable speculation and study on the part of the early horticulturists and mycologists both in this country and in Europe. De Bary (1861) established beyond doubt the causal relationship of *Phytophthora infestans* (Mont.) de Bary to the disease and, among other things, determined most of the essential facts in the life cycle of the pathogen as they are now known. In spite of contributions made to the knowledge of potato blight within the past century, doubt exists as to the origin of inoculum for primary infections. The question still remains, how does the blight pathogen overwinter and become established each year? It is the expressed opinion of many that the diseased shoot from a diseased tuber as described by de Bary occurs too infrequently under field conditions to be effective in establishing the disease from year to year. The occurrence of diseased aerial shoots from infected seed pieces has, in fact, been so rare that it has been regarded as worthy of special mention in publication.

The area of the South Fork of Long Island is an intensive potato raising section in which the current season spread of the leafroll virus makes it necessary to import new seed each season This area is ideally suited for studies on the overwintering of *P. infestans,* for late blight, with but few exceptions, makes an annual appearance. This area is bounded on three sides by water and on the fourth and west side by a stretch of land unsuited for most agricultural purposes. Fog and rain usually occur with southerly or easterly winds off the Atlantic Ocean. Although these winds are accompanied by conditions favorable for the development and spread of *P. infestans* they, at the same time, exclude all possibility of wind borne inoculum capable of initiating the disease. The north or northwesterly winds are drying land breezes, unfavorable for the development of blight.

Infected Shoots Produced from Diseased Seed Pieces:

De Bary (1861) suggested that diseased aerial shoots may arise from infected seed pieces. He failed to prove his theory, however, until

1876. Among others who have noted that diseased shoots may arise from infected seed pieces may be mentioned Jensen (1887), Melhus (1915), Pethybridge (1911), Salmon and Ware (1926), Alcock and McIntosh (1927), and Murphy and McKay (1927). Unsuccessful in their attempts to produce diseased shoots from infected tubers were Kuhn (1870), Hecke (1898), Clinton (1906), Jones *et al* (1912), Lohnis (1922) and others

In the experiments conducted on Long Island, seed of the variety Green Mountain was inoculated with *P. infestans* in such a manner that when the tubers were cut longitudinally, each half contained a lesion of approximately the same size and location. A total of 90 seed pieces in groups of 30 were planted in soil which had never before supported a crop of potatoes. The plants were enclosed in cages covered with waterproof paper. To test the possibility of the fungus infesting the soil surrounding infected seed pieces and shoots, the lower leaves in one set of plants were pinned to the soil, in another group they were immediately excised, and in the last set, the soil was covered with waterproof paper. Diseased individuals were removed as soon as noticed.

Fifty of the inoculated seed pieces failed to grow; thirty-one gave rise to apparently healthy plants, while nine seed pieces or ten per cent of the total number produced diseased aerial shoots These shoots were not all produced at the same time but appeared over a period of several weeks. Some shoots were small and died soon after emerging above ground, although others superficially appeared normal. In the former case the pathogen soon invaded the entire shoot, while in the latter only part of the circumference of the stem was invaded. The discoloration on the stem could be traced back to the center of infection on the tubers in all cases. After a period of twenty-four hours infected shoots that had been placed in moist chambers were covered with mold and the organism was positively identified as *P. infestans*. In no other way did infection of the plants take place than by the growth of the fungus up through the shoot from the diseased seed piece. Most of the seed pieces which failed to produce plants had sprouted but the sprouts were killed before they reached the surface of the soil. The size and location of the lesion on the seed piece may be the critical point in the production of diseased shoots. Too large a lesion or a lesion located too close to an eye may result either in rot of the tuber or destruction of the eye before a shoot has become established.

Under field conditions results of this nature would be expected with only a very small percentage of infected seed pieces actually producing diseased aerial shoots. Infected aerial shoots produced from diseased seed pieces were actually observed under field conditions on Long

Island Such infected plants were rare and existed for only a short time early in the growing season "Spot infections" in a field in which the disease spreads in a centrifugal manner from a few primary foci is not an uncommon observation. It has been noted by Melhus (1915), Brooks (1919), Beaumont (1934), and Crosier and Reddick (1935) and others who have worked in areas where blight annually makes its appearance.

Under normal conditions the incidence of tuber rot caused by *P. infestans* is very small on Long Island. It is possible, however, that diseased tubers left in the field at digging time might survive the winter in favorable locations and produce infected volunteer plants the following spring. A search was made for volunteer plants in grain fields on which potatoes had been produced the year before. Infected potato plants were readily found but none of these appeared to have been produced from diseased tubers.

The cull pile as a source of inoculum has been incriminated by Bonde and Schultz (1943). Plants growing on the cull pile have been observed to be infected on Long Island early in the month of June. The disease was observed spreading from the cull pile to adjacent fields.

A number of hypotheses have been advanced to supplement the infected shoot as the source of primary inoculum. Among these may be listed mycelium from infected seed pieces or shoots infesting the surrounding soil; sporangia or swarm spores infesting the soil surrounding infected seed pieces; mycelium existing saprophytically in the soil, overwintering spores, and other suscepts, as for example, perennial solanaceous weeds.

Sporangia or Swarmspores Infesting the Soil Surrounding Infected Seed Pieces

Data which may be interpreted as indicating that sporangia or swarmspores produced in the soil are ineffectual as inocula for primary infections on Long Island were presented by Skaptason *et al* (1940). It was reported that sporangial germination in soil obtained from potato fields on Long Island was greatly reduced when compared to germination on soils on which a crop of potatoes never has been grown. In the area of the South Fork of Long Island, Bordeaux mixture has been universally used for many years in the control of late blight The copper content of these soils was shown to be high in both total and replaceable copper and it was suggested that copper might be responsible for the reduction in sporangial germination

Further germination tests were conducted in soil obtained from the greenhouses in Ithaca, New York, and from a number of widely separated potato fields on Long Island. All tests were conducted in

moist chambers. Small but equal amounts of soil were placed directly on glass slides. Measured amounts of distilled water were added in such a manner that a film was formed around the periphery of the soil samples. Sporangia were introduced into the film of water immediately or after a period of 72 hours had elapsed. The slides were subjected to optimum temperatures for the germination of sporangia. A spore dilution of approximately 150 sporangia per low power microscopic field was used and the germinated individuals in a total of 400 sporangia were counted per treatment This experiment was duplicated.

The results of this experiment (table 1) show that the period of leaching had very little effect on the rate of sporangial germination which occurred only in soils obtained from the greenhouses in Ithaca. Slight sporangial germination occurred in the soil samples taken from

TABLE 1.—*Percentage sporangial germination in suspensions made from soils obtained from the greenhouses at Ithaca, N. Y., and from potato fields on Long Island.*

Soil Samples	Period of Leaching in Hours	
	0	72
Plant Science Greenhouse, Ithaca	82 4	52 5
Potato Greenhouse, Ithaca	57 8	10 4
Sagaponack 1	s	s
Sagaponack 2	s	s
Sagaponack 3	—	—
Sagaponack 4	—	—
Sagaponack 5	—	—
Sagaponack 6	—	—
Southampton	—	—
Bridgehampton	—	—
Watermill	—	—
Commack	—	—
Riverhead	—	—
Distilled Water	77 3	78 5

s—Slight sporangial germination.

fields Sagaponack 1 and Sagaponack 2. Both of these fields have been cropped to potatoes for only a few years Data of this nature substantiate that reported by Skaptason *et al* From a practical standpoint, the formation in the soil of sporangia or swarmspores which might function as inoculum for primary infections is of no importance in the annual outbreak of late blight on the South Fork of Long Island.

Saprophytic Existence of the Pathogen in the Soil:

The saprophytic existence of *P. infestans* in the soil was first suggested by Kuhn (1870) This hypothesis was supported by Brefeld (1883) chiefly on the basis of his success in culturing the organism on

an artificial medium. Darnell-Smith (1912) reported that potatoes planted in soil which he had infested with diseased tubers produced only healthy plants. Similar results were reported by Stewart (1913) and Clinton (1936). Observations of this nature have been the experience of most workers. Tucker (1931) reported the sporangia or oospores of *P. infestans* were not able to survive an exposure to low winter temperatures at Columbia, Missouri. Miss deBruyn (1922), however, reported that she was able to grow the fungus on sterilized soils such as clay, bog, leaf mould and sand. In 1926 she reported good growth of the fungus on sterilized plants from a number of unrelated families. Good growth was obtained on grass and on various cereal straws. On the basis of her experiments Miss deBruyn suggests that the fungus might live saprophytically in soils containing organic material derived from these plants

A number of unrelated plants and several types of soil were tested as potential media for the growth of *P infestans* and the results are presented in table 2. Growth of the organism was good on dried potato stems, barley, oat and wheat heads but very poor on the straws of these grains.

TABLE 2—*Growth of P. infestans on various substrata*

Substratum	Fungous Growth and Sporulation
Carrots	1
Equisetum stems	1
Polypodium stems	1
Dried potato stems	2
Barley heads	2
Oat heads	2
Wheat heads	3
Barley straw	4
Oat straw	4
Wheat straw	4
Cow manure	5 (1 2 cms)
Muck	5 (8 5 cms.)
Peat moss	1
Greenhouse soil	1
Sand	4
Sphagnum moss	5 (1 3 cms)
Soil No 5—Sagaponack	1
Soil No. 6—Sagaponack	1
Lima bean agar —check—	6 (8 5 cms.)

Legend: 1—No growth
2—Good growth
3—Excellent growth
4—Sporulation on the original piece of inoculum
5—Diametric growth at the end of 38 days
6—Diametric growth at the end of 12 days

Muck was the only soil on which the organism made any appreciable growth although in some of the others there was a profuse sporulation on the original piece of inoculum. The soil samples from Long Island were obtained from fields on which potatoes had been grown for many years. They contained organic material derived from crops of potato, wheat and rye as these crops are extensively used in the rotation system employed. The fungus, when planted on these soils, failed to sporulate even on the original piece of inoculum. These soils are known to have a relatively high copper content which, in all probability, functioned to prevent the sporulation of the pathogen in this test. A saprophytic phase in the life cycle of *P. infestans* existing in the soil and capable of accounting for the annual outbreak of late blight on Long Island is extremely unlikely.

Overwintering Spores.

On the basis of analogy with other species in the genus *Phytophthora* and with other members of the family Peronosporaceae many workers have been concerned with a search for the sexual reproductive organs *P. infestans.* Smith (1875) reported the presence of oospores in the leaf tissues of infected plants. The negative results of de Bary's search for oospores (1876) have placed Smith's work in disrepute. In 1890, Smorawski reported the presence of oogonia on infected tubers Jones (1909) and Jones and Lutman (1910) described the formation of resting bodies in cultures of *P. infestans* grown on gelatin or lima bean agar. It remained for Clinton (1911) to produce the sexual reproductive bodies of this fungus in artificial culture. Pethybridge and Murphy (1913) confirmed the results of Clinton Miss Lohnis (1922) reported that resting spores or immature oospores were formed on the surface of raw potato tubers, while Miss deBruyn (1926) states that oospores were produced on rye, oat and wheat straws, and to a lesser extent on *Equisetum* haulms and, in one case, on bog soil. Resting bodies were found on a variety of substrata—more so on old grass than on potato stems. Desiccated cultures of *P. infestans* survived an exposure to temperatures ranging from 20° to 26° C. for a period of five days Although no correlation existed between survival of the fungus and the presence of oospores or resting forms, these bodies were suggested as those most likely to resist both cold and drought Concerned with *P. infestans* on tomato, the report of Berg (1926) that antheridia and oogonia were formed on cultures obtained from Australia, England and Holland but were not formed in his American isolates is highly interesting. Murphy (1927) observed the formation of oogonia and antheridia on the surface of naturally infected as well as on inoculated

tubers. Clinton (1936) was unable to find oospores in nature nor could he find them in humus which previously had been heavily infested.

In the absence of positive data overwintering spores of *P. infestans* cannot be ruled out as a source of primary inoculum. However, the consistent failure of many workers to find oospores in nature, the large number of imperfectly formed sexual organs observed in artificial culture together with the failure to germinate those oospores found would seem to indicate, at the present time at least, that they are relatively unimportant in the overwintering of the fungus Further, in the area of Long Island, where sporangia will not germinate in the soil and into which the mycelium apparently will not grow, overwintering spores if found in the soil on the same basis would be unimportant as a source of inoculum for primary infections.

Perennial Solanaceous Suscepts:

The suscept range of *P. infestans* is confined to the Solanaceae Reddick (1928) quoting from numerous sources as well as from his own experiments, lists some of the members of this family susceptible to *P. infestans* of which the following are of interest: *Solanum Dulcamara* L., *S. nigrum* (detached leaves), *S Melongenum* (susceptible after exposure to humid conditions), *Schizanthus grahami, Anthero-cercis viscosa, Petunia* hybrids, *Lycopersicum esculentum, Lycium halmifolium* L., *L. turcomanicum* (detached leaves), and *Hyoscyamus niger* (detached leaves). Clinton (1936) could not find any evidence that the fungus overwintered on *Solanum carolinense, S. Dulcamara* or *S. nigrum.*

According to Taylor (1915) in his Flora of the Vicinity of New York, eight genera and twenty species of the Solanaceae are listed as growing wild within an approximate radius of 100 miles from New York. A number of the wild solanaceous plants as well as representatives of this family commonly raised in gardens or as house plants, were grown from seed When several true leaves were formed, they were inoculated with a culture of *P. infestans.* About five days later the plants were inspected and then subjected to at least ten hours of humid conditions. Notes were taken on the presence or absence of sporulation by the fungus.

Very few of the plants inoculated exhibited a marked susceptibility as is shown in table 3. By far the greater number of plants exhibited varying degrees of resistance. The symptoms ranged from a gradual yellowing and dropping of infected leaves to a few minute black spots. Plants exhibiting symptoms of the latter type, in the absence of sporulation, were classified as immune.

TABLE 3.—*Susceptibility of some solanaceous plants to P. infestans.*

Plants Inoculated	Annual or Perennial	Infection	Fungus Sporulation
Atropa Belladonna L	Perennial	+	—
Browallia speciosa Hook	Annual		
Capsicum sp.	Annual	+	—
Datura Metel L.	Annual	+	—
D Stramonium L.	Annual	+	—
Hyoscyamus niger L	Annual or Biennial	?	
Lycium halmifolium Mill.	Perennial	—	—
Nicandra Physalodes (L) Pers	Annual	+	—
Nicotiana rustica L	Annual	?	—
N. Sanderae Sander	Annual	?	—
Nierembergia sp	Annual	?	—
Petunia axillaris (Lam) BSP	Annual	+	—
P. violacea Lindl	Annual		+
P hybrida Vilm	Annual	+	
Physalis angulata L	Annual		+
P Alkekengi L	Perennial	—	
P ixocarpa Brotero	Annual	—	—
P. heterophylla Nees	Perennial		—
P peruviana L	Annual	—	
P pruinosa L	Annual		—
P subglabrata Mackenzie & Bush	Perennial	—	—
P virginiana Mill	Perennial		
Salpiglossis sp	Annual	+	+
Schizanthus sp.	Annual	—	—
Solanum carolinense L	Perennial	?	—
S Dulcamara L.	Perennial	+	+
S nigrum	Annual	+	+
S. Melongena var. *esculentum* Nees	Perennial	+	—
S. Pseudo-capsicum L	Perennial	—	—
S. rostratum Dunal.	Annual	+	—

+=Infection or sporulation
—=No infection or no sporulation
?=Minute black specks, no sporulation

Only perennial plants would be important as possible sources of inoculum for primary infections. In this experiment, a number of perennail solanaceous plants were inoculated. Infection appeared to take place on *Atropa Belladonna, Solanum Dulcamara* and *Solanum Melongena* var. *esculentum.* Only on *Solanum Dulcamara,* however, could the fungus be induced to sporulate. Even this plant exhibited a degree of resistance in that infected leaves turned yellow and fell at the slightest disturbance. This plant never has been observed blighting in its natural habitat. The conclusion seems warranted that none of the perennial

members of the Solanaceae found growing wild on Long Island function as overwintering suscepts for *P. infestans.*

Summary

Infected aerial shoots were produced by the growth of mycelium from diseased seed pieces both under controlled and field conditions Infected plants growing in the cull pile also were incriminated as an important source of primary inoculum.

The germination of sporangia of *P. infestans* was markedly reduced or inhibited in soils obtained from potato fields on Long Island, due probably to the relatively high copper content of these soils. For this reason it is suggested that should overwintering spores be found they also would be unimportant in initiating the disease. No evidence could be obtained for a saprophytic existence of the pathogen in the soil.

Solanum Dulcamara was the only wild perennial solanaceous plant of the eleven species inoculated on which the fungus could be induced to sporulate It has never been found infected in its natural habitat

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SECTIONAL NOTES

ALABAMA

Alabama is completing the harvesting of its early commercial potato crop It has been a hectic season from start to finish. The growers have fought weather, blight, and discouragement. In addition to these trials, they harvested a 60 per cent crop on 17,000 acres. The percentage of No. 1 B size was high, thus forcing the support program to take quite a quantity of B size for dumping It is needless to say that the dumping program was severely criticized

The market did not like the Sebago as well as the Triumph. Our growers received $2.25 for U. S No. 1, whereas the U. S. No. 1 Triumph variety brought $3 00 Despite this, the Sebago will hold its percentage of our total plantings. (June 3) —FRANK GARRETT

INDIANA

Much of our potato crop is still to be planted since we have had continuous rains in many places, and the muck soils, particularly, are still quite wet This may mean another week or so before they can get into some of these fields. The season is quite backward in all sections. In the central and southern part of the state potatoes are in the blossom stage at the present time and an examination of a 6-acre field on May 22nd, revealed that late blight had already made its appearance.

Surely something can be done with the surplus of potatoes. A picture of a potato dump covered with kerosene, with a legend underneath it saying that total destruction was desired of a large pile of potatoes, appeared in the Lafayette paper Saturday evening and in the past 48 hours considerable unfavorable comment has developed. I wonder why the producers of these potatoes don't have something to say about what is to be the disposition of their crops (May 26).—W. B. WARD.

MISSOURI

The prospects for the 1947 commercial potato crop in Missouri looks quite favorable at this time. Despite a late start most of the potatoes are growing well and the first fields of Cobblers are in full bloom. We have had more rain than was needed and the temperature on the average has been cooler than normal.

Weather conditions are favorable for blight but as yet no blight has been reported. Most fields have had at least two applications of copper-DDT dust, and one or two additional applications will be given before harvest time. A 6 per cent copper and 3 per cent DDT dust is in

common use. Tractor-type dusters are used in most fields, with airplane dusting being used only on a very limited scale. Airplane dusting may be used more later in the season because of the increasing difficulty of getting tractor wheels through the row middles without damage to the plants.

The current outlook would indicate that digging will probably begin the first week in July. (June 7).—ALLEN PURDY.

NEW JERSEY

Because of the excellent weather conditions, our potatoes are making rapid growth throughout the state. Most plantings show fair to good stands, although there are numerous fields with poor stands. Some of these poor stands were caused by fusarium rot in the seed pieces and some to excessive rainfall, which has drained out the potatoes in many low poorly-drained areas.

Potato plants that were frozen to the ground on the 9th and 10th of May have made good recovery in most instances and relatively little damage was caused Many fields of Cobblers are now in bloom,—especially in South Jersey. Harvesting will not start until approximately the 10th or 15th of July because of the late planting this season.

Some growers have expressed disappointment in some of the provisions required by P M A in order that they become eligible for price support Among these provisions is one that requires the grower to pay the government 1 cent per cwt. on their estimated production, when their application is filed. (July 11 is latest date). It is felt that growers should be allowed to make the payment at the end of the season rather than before they start harvesting, first because some will have to borrow the money; and secondly, because the estimates may be very misleading. It is also pointed out that no rebate will be made if the grower overestimates his production and no tolerance will be allowed for overplanting his allotment

The entire executive committee of the Potato Association of America met at Rutgers University from the 2d to the 4th of June, and drew up a new constitution. They also made other important plans for future activities of the association. The members of this association may rest assured that the future of their association is in competent hands (June 18) —J. C. CAMPBELL.

NEW YORK

Ordinarily potato growers begin planting in up-state New York about the last week in April, some before that. But on the 31st of May we found very few potatoes planted except in the very earliest and

driest areas. During the month of May, according to the United States Weather bureau, there were five days when it did not rain.

Because of the lateness of the season many growers have sold some of their seed. On the other hand this will not affect the acreage much because other growers have increased their acreage since it is too late to plant some earlier crops such as grain which some of our growers use in their rotation.

The fertilizer allotment was about 10 per cent under last year's planting but present indications are that the actual acreages planted will be about 20 per cent under last year. With a light acreage and planting a month later than usual we expect very light yields compared with normal and consequently a lot less than last year. Some of our serious minded potato men will not worry about a potato shortage and think there will be a surplus for next fall and winter.

The demand for certified seed has been good all spring and the supply was cleaned up rather early Actually there was a shortage of certified seed in some areas because of the sudden rise in the table stock market which, coupled with bad weather and the late season, induced some growers of certified seed to sell for table stock.

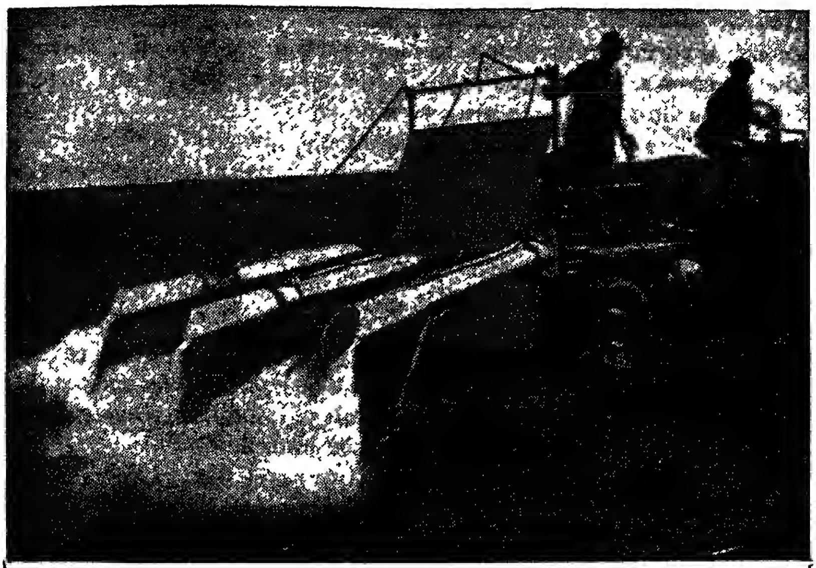
The biggest potato event in up-state New York this season will be the summer field meeting of the Empire State Potato Club at Richford on the 7th of August. We already have plans well laid out for more demonstrations than usual and manufacturers of machinery are cooperating 100 per cent This year we will feature besides potato machinery other equipment such as bull dozers, road scrapers, etc, which can be used to kill hedges; construct diversion ditches, burying stone piles and other improvement projects.

The College of Agriculture has five acres for plots showing new varieties, the results of various fertilizer applications, insecticides, fungicides, etc. (May 31).—H J Evans.

OHIO

Both April and May have been very wet in Ohio. The rainfall was below normal the first three months of the year, and although the total rainfall to date is not so much above normal, still the rainfall in both April and May was far above normal so that we had a total of more than 10 inches of rain during these two months. The rains during these two months were not so heavy, but it rained so many days that it kept the growers from planting potatoes.

The Cobblers are planted in the southern half of the state, but there are practically no potatoes planted in northern Ohio. Some of the



Cobbler seed in northern Ohio has been sold for table stock. There is time to grow a crop of Katahdins in the northern part of the state if they are planted within the next week or so.

If we have dry hot weather during the summer our crop, as a whole, will be late, and we can expect a reduction in our yields in this state. (June 4).—E B. TUSSING.

OREGON

In common with most of the rest of the country, Oregon potato acreage was substantially reduced this year. It is likely that acreage of certified seed will also be reduced. We had over 5,000 acres entered in 1946 and indications are that not more than 4,000 will be entered this year. Last year we rejected about one-half of the total acreage entered. Rejections last year were mostly caused by leafroll.

Government purchases in this state were less than in some of the other states because of the fact that during most of the year the f.o.b. price for good table stock was at or above the support price. We had one serious situation, however, that resulted in purchases of a great many carloads. Leafroll was exceptionally serious and the current season form resulted in net necrosis or internal browning of some of the tubers. Of course, it was impossible to sort these out and whenever a grower discovered that he had internal browning in enough of his crop to cause it to be rejected when sold to a commercial buyer, he immediately turned that to the Government.

This, of course, made a very handy thing for him, but as soon as government support prices are out, that method of disposing of potatoes affected by leafroll will no longer be possible. In fact, government agencies have already announced that they will not accept such lots if offered to them in 1947.

Had it not been for this internal browning situation, there would have been very few potatoes turned to the government in this state last year. It is not anticipated now that there will be any need for government purchases this coming year in Oregon. (June 11).—E. R. JACKMAN.

PENNSYLVANIA

Planting is late and still is not finished, but should be completed about the 20th of June The inclement spring weather has resulted in a cut in acreage, which, when added, to the reduction resulting from the high cost of labor amounts to 10 per cent The trends in potato production are toward specialization. The small grower is dropping out of production or increasing his acreage to 100 acres, or even more. Another

trend is toward white skinned-varieties of the season of Katahdin. Rural Russets are losing in favor and Cobblers are being grown in only a few counties.

Most farmers are using more fertilizer than in the past,—1,500 pounds or more per acre applied in bands along the row. Some growers are plowing down an additional 500 pounds. This increase in amount of fertilizer applied is based on farmer's experience rather than experimental results (June 3).—O D. BURKE.

SOUTH DAKOTA

Potato planting in South Dakota is still under way in the area at this writing, the 5th of June. The season was very late and growers, who also raise small grain did not get started planting potatoes until around the first of June. The acreage will be about the same as last year or possibly 5 to 10 per cent less Much new foundation seed has been shipped into the area from Wisconsin, Minnesota and North Dakota.

Potatoes that were planted by the larger growers in May are beginning to come up but it does not look as if there will be any field inspection work before the 23rd or 24th of June. David Giese, formerly of Moorehead, will again be the head field inspector for the South Dakota Potato Growers' Association.

A hearing on a proposed marketing agreement will be held in Watertown on the 19th and 20th of June by the Solicitor's Office from Washington. The present plans are to include all of South Dakota East of the Missouri River in the agreement, but this area may be changed as a result of the hearing. Mr. R. E Keller, of the Fruit and Vegetable Branch from Chicago, has explained the marketing agreement to growers

The State Potato Advisory Committee met in Watertown the 29th of May and recommended marketing survey allowances for the 1947 crop.

It is doubtful if the annual tour of the potato growers will be resumed this season. This was always a leading event in potato circles and was usually held about the 18th or 20th of July. (June 5).—JOHN NOONAN.

CANADA

During the month of May a seed company in London, Ontario, fumigated their warehouse for rodents, using larvacide (Chloropicrin) at the rate of 50 pounds to 197,500 cubic feet

There were approximately 200 bags of certified seed potatoes stored

in the warehouse at the time of the fumigation. In due course these potatoes were sold to growers When the growers started cutting the seed they discovered that the tubers showed depressed areas, varying in size from 1/8 of an inch to patches covering most of the tuber. In addition, the eyes were mostly dead The growers returned the seed to the company, who called in the local inspector of the Plant Protection Division of the Dominion Department of Agriculture. At first no explanation was given, but the local inspector was asked to investigate the matter throughout, and it was then discovered that these potatoes were in the warehouse at the time of the fumigation. As practically all the eyes were killed, the certification tags were removed from the bags and the Department of National Health and Welfare asked to ascertain if these potatoes were fit for food.

This Department reported that the potatoes could be decontaminated by airing for 24 to 48 hours. No residue was found in cooked potatoes, and the flavor was unimpaired

Incidentally, the rodents were all killed (June 7).—J. W. SCANNELL.

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NEW BRUNSWICK N J

STORAGE OF SOUTHERN-GROWN POTATOES DURING THE SUMMER

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INTRODUCTION

Potatoes are generally grown in the south as a spring crop Since they are harvested about 90 days after planting, they are marketed before they are fully mature. Probably the most important reason for harvesting potatoes in this immature state is that the price generally drops as the season progresses. Another reason for harvesting early in much of the south is that if the potatoes are left in the ground too long they are subject to decay both in the field and after harvest, caused by *Sclerotium rolfsii* (6). In addition some other crop usually follows potatoes and there is often a desire to remove the potatoes to make way for the succeeding crop.

Immediately after the shipping season from the south ends, it is necessary to ship in potatoes from more northern points. Often southern potatoes are sold at very low prices and later, when potatoes are shipped in from the north, prices become much higher.

Many cold storage locker plants which have been built for the freezing preservation of foods have non-freezing rooms maintained at 32° F., or above, that can be utilized for storing fruits and vegetables in a non-frozen condition.

[1]Physiologist.

The experiments reported herein were conducted to determine the possibilities of various methods of storing southern-grown potatoes harvested in the spring or early summer,

Review of Literature

Practically all of the experimental storage work reported in the literature has been on late-crop potatoes which are generally harvested in a more or less mature condition. Only recently has there been work reported on storing early-crop potatoes

Cordner (2), working in Oklahoma, found that in cellar storage, potatoes held up as long as the temperature remained in the low seventies but that decay developed quite rapidly when the cellar temperature reached 80° F. He reported that at 50° there is practically no decay, and shrinkage is held to a low rate He recommends a curing period ranging from 10 days to 2 weeks in a cellar at a moderate temperature (about 70°) and in a moist atmosphere before placing them in refrigerated storage Kimbrough (5) also recommends curing for one to two weeks before cold storage at 35° to 40°, in the case of Louisiana-grown potatoes. He found a storage temperature of 40° superior to 35°

Materials and Methods

The experiments reported herein were conducted in 1941, 1942, and 1944 at the U S. Horticultural Field Station, Meridian, Mississippi, with the Bliss Triumph variety In 1941 the potatoes were harvested on the 4th of June at Columbia, Mississippi In 1942 and 1944 the potatoes were obtained near Meridian, Mississippi, and were harvested on the 24th of June in 1942 and the 9th of June in 1944. The storage experiments were started the day after digging The growing season was dry in 1941, wet in 1942, and about normal in 1944 There were some enlarged lenticels on the potatoes in 1942 but those that were especially bad were discarded prior to storage.

Four half-bushel baskets of potatoes were used for each treatment each of the first two years, and three baskets in 1944. Those in non-refrigerated storage were examined after 2½ months Two baskets of each treatment in refrigerated storage were inspected after 2½ months' storage and the remaining two after five months' storage.

The five storage conditions used in 1941 and 1942 together with the temperature and humidity of each are given in table 1 The basement storage was kept as cool as possible by opening the doors and ventilators at night and closing them during the day. For each storage condition there was a non-cured lot as well as one lot cured one week

at 60° F. and another cured one week in a shed (average temperature — 81 1°) prior to storage.

TABLE 1.—*Temperature and humidity in various storage conditions.* (1941 *and* 1942.)

Storage Conditions	Temperature			Relative Humidity		
	Ave.	Min	Max.	Ave.	Min.	Max.
	°F	°F	°F	Per cent	Per cent	Per cent
Shed	81 1	69 0	94.0	72 2	35	96
Basement	78 0	66 0	89 0	81.0	49	91
60°F	60 1	58 5	70.0	81.6	71	94
50°F	50 4	48.5	69.0	79 3	62	95
40°F	40 3	38.5	59.0	80 4	63	97

The differences required for significance between treatments were determined by the analysis of variance method.

The quality was determined by baking a sample of five potatoes from each treatment The sugar content was determined on alcohol-preserved samples by the Quisumbing-Thomas method, the cuprous oxide being determined by the volumetric permanganate method. A representative portion of each of 25 tubers was taken for a sample

RESULTS

Decay and Weight Loss in Non-Refrigerated Storage

Weight loss and decay were very high in both the shed and basement storage, as in shown in table 2.

TABLE 2—*Percentage decay and loss in weight after 2½ months under non-refrigerated storage conditions.* (1941 *and* 1942.)

Curing	Percentage Decay at Storage Method Indicated		Loss in Weight at Storage Method Indicated	
	Shed	Basement	Shed	Basement
	Per cent	Per cent	Per cent	Per cent
None	35 0	35 5	19 6	12.6
60°F—1 week	29 3	32 1	15 7	10 8
Shed—1 week	—	25 7	—	10.8

Difference required for significance between treatments: Decay—6 7 per cent. Loss in weight—2.5 per cent

From these results it is evident that losses would be too high to warrant storage of Bliss Triumph potatoes for as long as 2½ months during the summer under conditions such as prevail at Meridian, Mississippi, at room temperatures averaging about 81° or even in a basement storage averaging 78° LeClerg (4) suggests that since the Katahdin, which is a white-skinned potato, keeps well in storage, growers should find this variety well adapted for supplying the local and southern market after the early shipping season is completed Kimbrough (6) also found that the Katahdin keeps much better in common storage than the Triumph

There have been some reports of potatoes keeping during the summer months under non-refrigerated conditions if they are spread out in a single layer and stored in a shed or under a house There have also been reports of potatoes keeping well if sprinkled with hydrated lime. In order to determine the value of these methods, the following treatments were used in 1944

1 Check—in basket.
2 Potatoes spread out in a single layer
3 Potatoes in basket; ½ pound hydrated lime sprinkled on top of potatoes
4 Same as 3 but entire surface of all potatoes covered with lime

After storage in a basement for approximately 2½ months there was essentially the same percentage decay in all treatments,—averaging about 15 per cent

Decay and Weight Loss in Cold Storage—Weight loss and decay in storage and decay during a one week's holding period at room temperature after removal from storage are given in table 3.

The greatest weight loss occurred in the potatoes stored in 40° F without curing, whereas the least loss occurred in potatoes stored at this temperature for 2½ months after being cured at 60° F. for one week. The skinned areas on more than one-half of the tubers stored without curing became sunken and dark (Figure 1) These skinned areas failed to suberize and consequently continued to lose moisture throughout the storage period None of this injury was present on potatoes stored at a higher temperature and practically none in those cured for one week prior to 40° F storage. Artswager (1) has shown that healing of cut surfaces of potatoes occurs very slowly at low temperatures, especially below 50°, but at higher temperatures this healing, which involves suberization and wound periderm formation, takes place quite readily

In order to determine the influence of length of curing necessary to prevent this injury, a lot of potatoes was subdivided into 7 sub-lots

TABLE 3—*Weight loss and decay of potatoes stored in cold storage.* (1941 *and* 1942)

Storage Temperature	Curing	Weight Loss		Decay in Storage		Decay During 1 Week Holding at Room Teemperature after Removal from Storage	
		2-½ Months' Storage	5 Months' Storage	2-½ Months' Storage	5 Months' Storage	2-½ Months' Storage	5 Months' Storage
°F		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
60	None	7.1	13.0	1.6	2.0	0	0
	Shed—1 week	7.8	14.2	2.4	6.5	1.0	0
50	None	7.9	11.6	1.2	2.2	0.4	0
	Shed—1 week	7.6	10.6	0.7	2.4	0.4	0
	60°F—1 week	6.6	10.8	[illegible]	1.0	0	0
40	None	10.7	15.1	3.2	6.6	10.9	3.5
	Shed—1 week	6.8	8.3	0.7	0.4	0.3	0
	60°F—1 week	5.9	9.3	0.6	0.7	0.3	1.0

Difference between treatments required for significance: Weight loss—1.6
Decay in Storage—Differences not significant
Decay during 1 week of holding—4.4

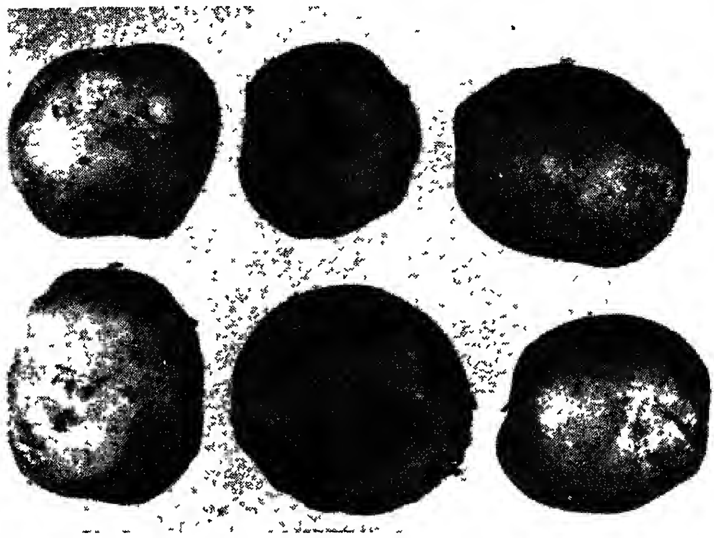

FIGURE 1—Potatoes stored 2-½ months followed by one week at room temperature

Not Cured	Not Cured	Cured 1 week at 60° F.
Stored at 50° F	Stored at 40° F	Stored at 40° F

in 1942. These were cured 0, 1, 2, 4, 7, 11, and 14 days in a shed When examined after 2½ months' storage at 40° F, it was found that potatoes cured for one day had about one-half as much injury as those not cured, and the potatoes cured two days showed about one-fourth as much, whereas those cured four days or longer were practically free from injury.

Decay in cold storage was not great in any of the treatments, but during a one week's holding period after being held 2½ months in storage the potatoes that were stored at 40° F without curing developed a significantly higher percentage of decay than any of the others This decay developed in the sunken discolored areas mentioned above

The studies reported herein were made on potatoes of good quality Parsons (7). working with early-crop Kansas potatoes, reported that deterioration and shrinkage were severe in cold storage where decay and sun damage were among the defects.

Influence of Storage Method on Sprouting, Shriveling and Color—It can be noted in table 4 that sprouting was held in check at 50° F. for 2½ months and at 40° for five months although some sprouts were emerging at 40° after five months' storage Wright and Peacock (9) found a tendency toward a shortening of the rest period as the storage temperature was increased

TABLE 4—*Influence of lengths and method of storage on sprouting, shriveling and skin color* (1941 *and* 1942)

Storage Method	Sprouting after Storage Period Indicated		Condition after Storage Period Indicated		Skin Color after Storage Period Indicated	
	2-½ Months	5 Months	2-½ Months	5 Months	2-½ Months	5 Months
Shed	Starting—Sprouts ⅛ to 1 inch long	—	Somewhat shriveled	—	Considerably faded	
Root Storage	do	—	do	—	do	
60°F.	do	Sprouts 1 to 2 inches long	Slightly shriveled. Some turgidity lost	Badly shriveled and spongy	Somewhat faded	Badly faded
50°F.	None	Sprouts emerging to 1 inch long.	Excellent[1]	Still marketable but somewhat shriveled	Good	Somewhat faded
40°F	None	Generally none Some emerging.	Excellent[2]	Excellent[3]	Good	Good

[1]Slight shriveling in non-cured potatoes stored at 50° F after 1 week at room temperature
[2]Non-cured potatoes stored 2½ months at 40° F were somewhat shriveled.
[3]Non-cured potatoes stored 5 months were badly shriveled and spongy

In these experiments the tubers were kept free from shriveling for 2½ months at 50° F, and for five months in the cured lots stored at 40° The skin color remained free from visible fading for 2½ months at 50° and for five months at 40°

Quality

The flavor of potatoes stored 2½ months under non-refrigerated storage conditions was generally satisfactory although in some cases it was slightly stale or aged The flesh color was slightly yellowish especially in the case of those stored in the shed. In 1941 it was noted that some of the potatoes stored at these high temperatures was slightly hard.

After 2½ months' storage at 60° F flesh color and flavor were good in 1941, but there was a trace of yellowing in 1942. A little sogginess was noted in 1941 After 2½ months' storage at 50°, flesh color, texture, and flavor were good After storage at 40° for this length of time, the flesh color was good and the texture was generally good but was somewhat waxy in 1942. The flavor was decidedly sweet in the non-cured lot stored at this temperature The cured lot, although somewhat sweet, had less sweetness than the non-cured lot

After five months' storage at 60° F the flesh color was slightly yellowish and the texture and flavor fairly good Storage at 50° F for five months resulted in potatoes that were of good color and flavor but only of fairly good texture Potatoes stored five months at 40° had a good color but were somewhat soggy and the sweetness apparently remained unchanged during the interval since the examination after 2½ months

There was practically no change in flesh color, texture, and flavor during a one week's holding period after removal from storage except that in the lot stored at 40° F some of the sweetness disappeared Although there was still some sweetness in the cured lots stored at 40° after they had been held for one week at room temperature, it was not particularly objectionable

The influence of storage temperature on carbohydrate composition and its influence on quality has been investigated by Wright *et al* (10) Potatoes stored at 36° to 40° F were only fair in quality when steamed, boiled, or baked When made into French fries, potatoes stored at 40° or lower were considered not edible For potato chips, only those stored at 60° to 70° were considered desirable Denny and Thornton (3) have shown that the color of potato chips is related to the reducing sugar content of the potatoes from which they are made They found marked differences between varieties in their susceptibility

to sweetening at low temperatures. Bliss Triumph was one of the varieties that tended to have a very high reducing sugar content when stored at low temperatures.

Influence of Storage Temperature on Sugar Content

The total sugar content and the reducing sugar content of potatoes after 2½ and five months' storage, together with the sugar content after a week's holding period at room temperatures subsequent to removal from storage, are given in figures 2 and 3. The sugar content was much greater in potatoes stored at 40° F. than in those stored at

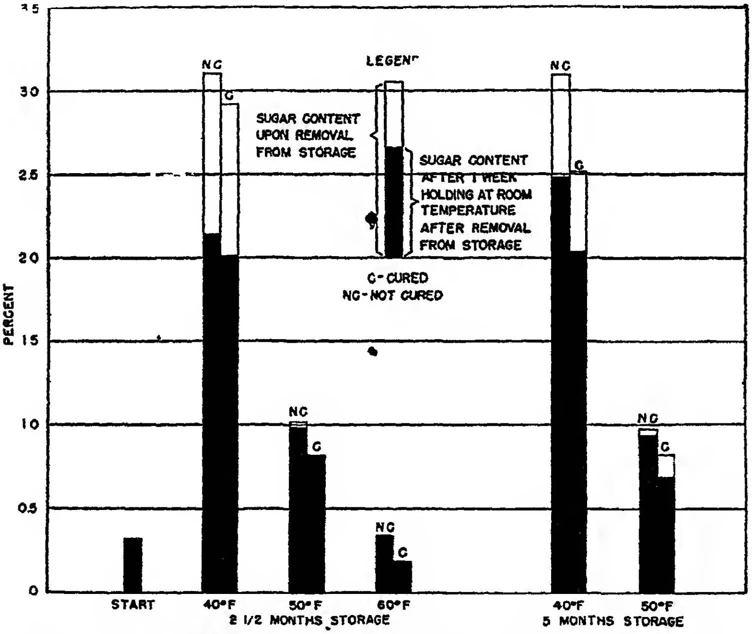

Figure 2.—Total sugar content of potatoes stored at various temperatures.

higher temperatures. There was less sugar in the cured lots stored at 40° than in those not cured. The sugar content decreased in potatoes with high sugar content during the one week's holding period after removal from storage. This is in accord with the recommendation of Rose, Wright, and Whiteman (8) who suggest a few days' exposure at ordinary living-room temperature to restore the natural flavor of potatoes which have sweetened in storage.

Although the sugar content was higher in potatoes stored at 50° F. than at 60°, it apparently was not high enough to affect the quality.

In order to determine the influence of the length of curing on the

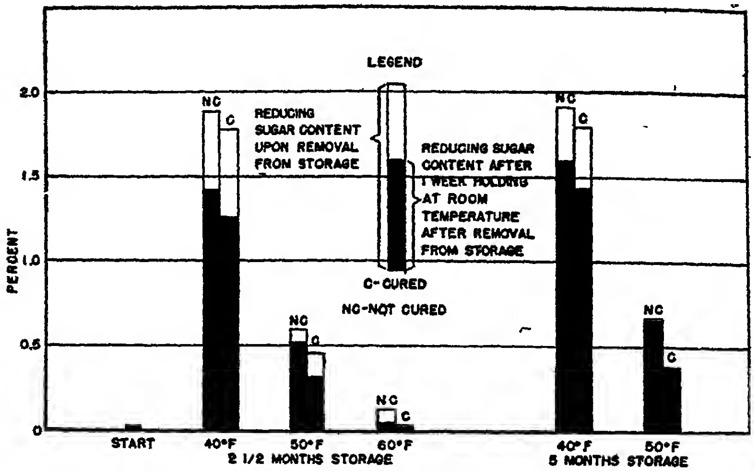

FIGURE 3—Reducing sugar content of potatoes stored at various temperatures

sugar content of potatoes stored at 40° F, the sugar content of potatoes cured in a shed for the periods indicated in table 5 was determined

TABLE 5—*Influence of length of curing period on sugar content of potatoes stored 2½ months at 40° F followed by a one-week holding period at room temperature.*

Length of Curing Period	Reducing Sugar	Total Sugar
Days	Per cent	Per cent
0	1 42	2.14
1	1 32	2 04
2	1 22	1.82
4	1.18	1.98
7	1 26	2.02
11	1 12	1.64
14	1 10	1.58

after 2½ months' storage plus one week at room temperature. In general, the reducing sugar content decreased with increase in length of curing period, from 1 42 per cent in the non-cured potatoes to 1 10 per cent in those cured 14 days prior to storage. The total sugar content showed a similar decrease, from 2 14 per cent to 1 58 per cent. When baked, the flavor of potatoes cured 11 and 14 days was quite satisfactory, being practically free from objectionable sweetness

SUMMARY AND PRACTICAL APPLICATIONS

Storage of Irish potatoes under non-refrigerated conditions, such as in a shed or basement, resulted in very high losses Spreading the

potatoes out in a single layer or covering them with hydrated lime did not improve their keeping quality.

For a storage period of 2½ months, potatoes kept in a satisfactory condition at 40° F if they were cured before storing, or at 50° or 60° whether they had been cured or not. The potatoes stored at 60°, although in fairly good condition, had started to sprout and showed some shriveling and loss in color

For a storage period of five months, only those potatoes stored at 50° F., either cured or not cured, or at 40° if cured, were satisfactory; but those stored at 50° were starting to sprout and were somewhat faded in color and shriveled.

Storage at 40° F. resulted in the development of considerable sweetness. There was less sweetness in potatoes that had been cured prior to storage, and still less after a one-week holding period at a room temperature of about 81° subsequent to removal from storage. As a result, cured potatoes stored at 40°, although still showing slight sweetness, were of acceptable quality when baked following a one-week holding period at room temperature after removal from storage.

Storage at 40° F. without curing resulted in a sinking and darkening of the skinned areas as a result of their failure to heal. This produced an undesirable appearance and considerable shrinkage, and predisposed these areas to decay after removal from storage. Curing at room temperatures of about 81° for four days or longer prior to storage practically eliminated this trouble.

For best results, if the storage period is to be two or three months or less, it is suggested that potatoes be stored at 50° F immediately after harvesting. If this temperature is not available, either 60° or 40° would be suitable, but they should be cured four days or longer at 60° to 80° before storage at 40°. It is suggested that the curing period be made as short as possible, especially if the curing is done at room temperatures, because of the danger of decay at this relatively high temperature. For five months' storage, cured potatoes stored at 40° had the best keeping quality, although those stored immediately at 50° had fair keeping quality

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DEVELOPMENTS IN POTATO BREEDING

Summaries of talks presented at the Potato Association of America meeting held at Chicago on December 2, 3, and 4, 1946

The National Potato Breeding Program which got under way in 1929 has resulted in the introduction of many new varieties, quite a few of which already are in commercial production Inasmuch as the program is expanding so rapidly we can no doubt look forward to increasing numbers of new introductions in the years ahead Many problems are involved and the Program Committee arranged a number of topics for discussion represented by the following summaries As a background for the various topics a brief historical resumé under the topic "Breeding New Varieties," setting forth some of the earlier attempts of originating potato varieties, the problems of testing and classifying them, the object of the National Potato Breeding Program, and the present status of potato varieties now in commercial production, was presented by the discussion leader.

The material presented gives a clear picture of some of the accomplishments attained and what is involved in originating a new variety and some of the methods used in properly testing before a new introduction is made.

Breeding New Varieties[1]

Probably the first attempt at potato breeding in the United States was made by Rev C E Goodrich of Utica, N Y, about 100 years ago The ravages of late blight furnished the incentive. Although he did not attempt hand pollination, he did obtain the Garnet Chili, a seedling from one of the varieties that he secured from South America The introduction of the Garnet Chili developed a widespread interest in potato breeding.

[1]Paper No 2347 of Scientific Journal Series Minnesota Agricultural Experiment Station, St. Paul, Minnesota A G Tolaas, University Farm, St Paul 1, Minn

Other breeders of that time were C G Pringle (Vermont), E. S. Brownell (Vermont), Alfred Reese (Early Ohio—from naturally fertilized seed ball of Early Rose 1870), Luther Burbank (Burbank 1873, seed ball Early Rose), E L Coy (Beauty of Hebron 1874—naturally fertilized seed ball of Garnet Chili) Of these men, Pringle was probably the most skillful, doing the actual crossing, selecting healthy plants of varieties for crossing with a definite purpose in view He sold the seed obtained by hybridization to seedsmen and growers This resulted in wide dissemination and production of many promising new varieties. Accordingly it is quite apparent that most, if not all, of the testing was done by growers

Up to about 1900 there were probably over 1000 varieties named This list contained many names that represented plants and tubers having the same characteristics, or in other words, the potato variety situation was in a state of confusion.

It remained for Wm. Stuart to bring order out of chaos as a result of extensive testing of varieties collected from all parts of the country. His bulletin entitled, "Group Classification and Varietal Descriptions of some American Potatoes," no doubt is familiar to all of you The classification of varieties into groups was an important step toward a satisfactory and intelligent study of the varieties themselves. It was shortly after the publication of this bulletin in which Stuart classified American Potato Varieties into groups having similar characteristics, that Seed Potato Certification got under way. We all had the same variety problem to contend with and Stuart's classification was a most helpful guide to those of us who had the responsibility of seed potato certification. A survey made in our own state in 1915 revealed that potatoes were being grown under 70 different names The first thing we did in our certification work was to recognize varieties under Stuart's group classification This soon cleared up the confusion which existed at that time.

For a period of about 30 years from 1884 to 1915, most introductions were obtained from naturally fertilized seed or as mutations from varieties already under cultivation Stuart developed the technique of breeding, and as a result of his careful methods, we have the Chippewa and Katahdin. The latter variety has served as a base for the development of many of the newer varieties under the present National Potato Breeding Program Since the breeding program got under way, some 30 odd new varieties have been introduced Some of these, together with the old standbys, have been included in an excellent bulletin by Clark and Lombard entitled, *"Description of and Key to American Potato Varieties."* Potato breeders engaged in the National Potato Breeding

Program have a definite procedure in introducing a new variety including origin, technical description, adaptability, culinary qualities, etc, which was not available for the many varieties included in Stuart's classification since so many persons are engaged in this new potato breeding program and since the introduction of new varieties is increasing rapidly, a revision of Clark and Lombard's bulletin about every five years would be highly desirable in order to keep us accurately informed of the progress that is being made, and it would have the additional advantage of containing the necessary information about the varieties introduced in one publication.

Since the *origination, development, testing* and *introduction* of new varieties involves many problems, the Program Committee thought it desirable to include in the program a few topics for discussion of some of the aspects of this important phase of our potato industry

Before calling on the speakers, it might be of interest to glance at a chart which I have made which might give some idea of the varieties now in commercial production. As you will note, these figures are based on the total production in bushels certified and war approved for the year 1945. The column at the right shows production of the ten leading varieties grown in Minnesota

VARIETY TRENDS BASED ON CERTIFIED SEED POTATO PRODUCTION IN 1945

Ten Leading Varieties

United States—Per cent of Total Production		Minnesota—Per cent of Total Production	
Irish Cobbler	30.5	Irish Cobbler	58 39
Bliss Triumph	18 2	Bliss Triumph	16 26
Katahdin	10 6	Pontiac	9.75
Russet Burbank	8 33	Red Warba	4.2
Green Mountain	8 03	Chippewa	3 35
White Rose	5 06	White Rose	2 18
Chippewa	4 09	Early Ohio	1 86
Pontiac	3 5	Katahdin	1 04
Sebago	2 09	Warba	0 65
Red McClure	2 1	Sebago	0 63
Other Varieties	7 5	Other Varieties	1 69
Total bushels certified and war approved—42,057,335			

The percentage representing the ten leading varieties may not be 100 per cent correct, but since they represent most of the seed stock to be planted, I think that they do give a fairly accurate picture of the variety situation at the present time. In the line "Other varieties" are included

some of the old commercial varieties and many of the more recent introductions

Recent Developments in Potato Breeding[2]

It was hoped that Dr. F. J Stevenson could be with us to discuss the recent developments in potato breeding. I shall try to present a few salient facts concerning the scope of the potato breeding work, point out some of its accomplishments, call attention to some of the phases that are receiving major emphasis and give a few illustrations of the progress that is being made

The National Potato Breeding Program was organized at Chicago in 1929 The primary objective was to promote and encourage potato breeding work in the United States by providing a means to facilitate the exchange of information and material. It was followed by a fairly rapid expansion of potato breeding At the present time, work is in progress in 25 states, two territories, and by the U S. Department of Agriculture. Since 1929, there have been at least 36 varieties named and introduced The accompanying chart gives the names of these varieties and the approximate year of introduction It will be noted that the new introductions which were relatively few at the beginning, have gradually increased in number to a relatively large number of introductions in 1945. The number introduced in successive five-year periods, since the introduction of the Katahdin in 1931, is given in table 2. During the first five-year period, 1931-1935, five were introduced, six in the second five-year period, 1936-1940, and twenty-two in the next five-year period, 1941-1945. These figures reflect the increased interest and activity in potato improvement by breeding which has occurred since the National Potato Breeding Program was initiated.

The new varieties cover a wider range of maturity than the older varieties. Within the group of new varieties are found desirable characters not present in the older varieties These characters include greater uniformity in size, and shape, greater freedom from growth abnormalities, greater resistance to a number of the virus diseases, and high resistance to common scab and late blight.

In certain characters the new varieties are sometimes weaker than the older varieties. This is due to the fact that these varieties represent initial and incomplete stages in the progressive breeding steps leading to improved combinations of characters. I shall give a few illustrations.

Breeding for Resistance to Common Scab

The sources of resistance to common scab were varieties obtained from Germany such as Jubel, Hindenburg and Arnica. These are long

[2]F A Krantz, Division of Horticulture, University Farm, St. Paul, Minn

NAME OF VARIETY AND APPROXIMATE YEAR OF INTRODUCTION

Variety	Approx Year	Variety	Approx Year
1 Katahdin	1931	19 Cayuga	1944
2 Chippewa	1932	20 Mason	1944
3 Warba	1934	21 Erie	1945
4 Golden	1934	22 Alamaine	1945
5 Houma	1935	23 Ashworth	1945
6 Pontiac	1936	24 Beach	1945
7 Mesaba	1938	25 Calrose	1945
8 Earlaine	1938	26 Chenango	1945
9 Sebago	1938	27 DeSota	1945
10 Red Warba	1939	28 Empire	1945
11 Sequoia	1939	29 Lake	1945
12 Norkota	1941	30 LaSalle	1945
13 Mohawk	1942	31 Placid	1945
14 Pawnee	1942	32 Teton	1945
15 Kasota	1943	33 Virgil	1945
16 Allegheny Moun.	1943	34 Marygold	1946
17 Potomac	1943	35 Seneca	1946
18 Menominee	1944	36 Ontario	1946

season varieties The production of marketable tubers has apparently, whenever tested, been distinctly below that of the varieties commonly grown in the United States. The first step in breeding was to cross these German varieties with more adapted varieties and selections Selections from these initial crosses were widely tested Many of the best selections were found to rate high for resistance to scab Some of these had a combination of characters which approached the requirements for commercial production. A few of these as the Menominee Ontario, Cayuga and Seneca have been named and introduced These varieties and selections represented the completion of the first step in breeding for resistance to common scab. The next step was to cross these selections with each other and also with unrelated superior commercial types Selections from this second round of crosses are in various stages of test at the present time It is expected that some of these selections will be both resistant to scab and more satisfactory for commercial production than the selections from the initial crosses with the German varieties This work is being done at a number of the State Experiment Stations and by the U. S Department of Agriculture. The work has progressed to a point where increasing numbers of improved resistant varieties can be expected to be introduced

Breeding for Resistance to Late Blight

Resistant varieties appear to be one of the most promising means for the future control of late blight as well as common scab. The source

of late blight resistance has been *S. demissum,* a non-cultivated tuber bearing species of Solanum from Mexico and Central America. Another source of resistant material has been the W-races developed by Dr. K O Miller (Berlin, Dahlem). These W-races were developed from blight resistant material found in a collection of potatoes from Central and South America made by the U. S. Department of Agriculture

Dr. Donald Reddick of Cornell University has led in the development of blight resistant varieties. Starting with selected strains of *S. demissum* and by crossing with the cultivated potato he has developed and introduced the resistant varieties Empire, Placid, Virgil, Chenango and Ashworth. The U S. Department of Agriculture, starting with the W-races developed by Dr. Miller has developed resistant selections, some of which will probably be introduced in the immediate future. At the same time, Dr. Stevenson and his co-workers have found that resistance of tubers to rot caused by the late blight organism is closely associated with vine resistance. This information simplifies the work of testing for resistance, for less labor is involved in testing the resistance of tubers in the laboratory than that of testing the vines in the field The breeding for late blight resistance has passed the experimental stage and we have reasonable assurance that resistant varieties suitable for commercial production will be developed

Similar illustrations can be given for improvement in adaptability, market and culinary qualities. Each of these qualities consists of a large number of specific characters. The problem of the plant breeder is to develop a combination of these characters superior to the existing varieties For example we have been breeding for an improved early variety. The major weakness of the leading early variety, the Irish Cobbler, is the difficulty of putting up an attractive market pack with this variety The initial introductions in the early and midseason group such as Chippewa, Warba, Earlaine, Mesaba, Pontiac and Kasota, all had certain weaknesses in their combination of characters which has limited their usefulness Selections are now being increased which more nearly approach the combination desired. The improvements over the Irish Cobbler are (1) uniform large size with fewer under size tubers, (2) shallow eyes, and (3) a smooth even surface irrespective of size. Work is in progress to combine these characters with resistance to common scab and late blight in an early variety

It must be recognized that despite the progress that has been made potato breeding is still in its infancy The potential possibilities for the improvement of the potato is indicated by the fact that Dr. Stevenson was able to cite published work on 21 characters. These 21 characters

are scattered among many varieties, with relatively few of them in any one individual. The plant breeder by controlled pollination, testing and selection is constantly developing individuals with a larger number of desirable characters. Sooner or later in this program, individuals are obtained, with a greater number of the desirable characters than that found in a commercial variety These are introduced as new varieties in addition to serving as parental material in the continuing process of improvement In fact, they are usually employed as parents for further improvement a number of years before they have been sufficiently tested to warrant introduction as a new variety For example, Selections 47, 6, 35, 42 and 23 have been used for a number of years as a source of earliness rather than Cobbler, Triumph, Warba and Early Ohio.

Breeding for Blight Resistance[3]

Breeding for blight resistance, if successful, leads eventually to a whole series of new varieties, one to take the place of each standard variety From the purely commercial aspect the new variety must, in addition to its proofness, equal or exceed the standard variety in the characters that make it a standard. Complete revelation of all the characteristics of a new variety can scarcely be determined in the small-scale trials of the experimenter but rather must await the extensive trials of large-scale production Many new varieties will be produced but only a few are likely to stand the test of time On the other hand, potatoes are produced so extensively on a non-commercial scale that many varieties of restricted adaptation will find a place in limited areas providing only that it is not necessary to control blight.

The following varieties are either immune or very highly resistant to the blight caused by *Phytophthora infestans* Empire, Placid, Virgil, Chenango, Ashworth, Essex, Glenmeer, Harford, Cortland, Snowdrift These exist only in extremely limited quantities but all will be increased in 1947 and eventually will be available generally through regular trade channels.

Given a parent carrying the genes for resistance or immunity to blight, the breeding program differs from any other potato-breeding program only in that the elimination factor, the parasite, must be reckoned with at all times This organism, unlike some parasites, is not stable. Given the right vitamin, it can live and thrive on inert material in a test tube. Given the green leaf of a Cobbler potato it thrives and produces blight; given the green leaf of Empire it dies; but, given a senescent and yellowing leaf of Empire it produces a mild blight and

[3]Donald Reddick, Cornell University, Ithaca, N Y

during the process "acquires" the ability to attack a somewhat younger leaf; and, by repeated passage, it becomes virulent for the green leaves of Empire How many of the varieties mentioned above will react in the same way is not yet known but several unnamed seedlings which have been tested have not reacted in this way. It appears, therefore, that some varieties of potatoes lose their resistance factor by senescence and that others do not

These experiences relate to hybrids in the third or fourth backcross stage from *Solanum demissum* as female parent. This species has been used extensively by several breeders Other species from central Mexico which are immune have not entered the program because the initial crosses have not yet been effected.

PROBLEMS RELATED TO INTRODUCTION AND TESTING[4]

The acceleration of the National Potato Breeding Program resulting in increasingly large numbers of new introductions intensifies the problems related to introduction and testing. These is need for some agency to come into the picture to take over the increasing of stocks of seed of foundation seed quality of new varieties that are being intended for introduction or that have been introduced. If the industry expects the plant breeders to release any material quantity of potatoes of a new variety when it is introduced, the resources of the plant breeders, including time and funds, will be used up to a large extent on such work so that less will be available for the work of creating a new variety for which only the breeder is set up It is suggested that the Seed Certification Services or the Seed Potato Growers' Associations might very well take over this aspect, working of course in conjunction with the plant breeders If the plant breeder is to continue to produce improved varieties and at the same time be responsible for turning out foundation seed stock of the more advanced varieties, he either has to follow the alternative of cutting down on the other aspects of the program, or to turn out only a few bushels of foundation seed stock at a time With this latter method there is grave danger of the contamination of much of the seed stock and also a great likelihood that the variety will be increased so slowly and haphazardly that commercial quantities will not be available to the industries for several years longer than will be necessary if a well equipped organization takes over the job.

The people who market potatoes should assume more responsibility in connection with the introduction of new varieties Let me cite the Kasota variety in this connection. This variety has not come into use to the extent that it should because of the fact that dealers fear it does

[4]H O Werner, College of Agriculture, University of Nebraska, Lincoln, Nebr.

not have a sufficiently red color and that therefore they have marketed this variety as a Triumph and consequently have had some repercussions If marketed under its own name and own merits, and with little effort the Kasota would undoubtedly find a place for itself

Although dealers may feel that the important consideration is that of market quality rather than cooking quality, plant breeders have a responsibility in considering the intrinsic food value of potatoes They should endeavor to see to it that the lines which they release have good culinary qualities and high food value, and these aspects should be stressed in introducing a new variety I have in mind especially the desirability of potato varieties with high Vitamin C content and also having tubers of a high specific gravity.

Briefly, in Nebraska we propose the following plan The Experiment Station will continue to assume the responsibility of the breeding program and conduct comprehensive tests at a number of places and that the Foundation Seed Division of the Nebraska Certified Potato Growers Cooperative will assume responsibilities for developing a stock of foundation seed of selections which warrant serious consideration for introduction This does not necessarily mean however that all selections that are increased to a considerable extent will be disseminated if it appears undesirable to do so after the varieties have had further testing on a large scale.

Procedures in the Introduction of New Varieties[5]

Since 1932 approximately 40 new varieties of potatoes have been introduced through the efforts of the United States Department of Agriculture and about 30 cooperating state experiment stations. In most instances the new varieties have been superior in one or more respects to the old standard varieties In fact some of the new varieties because of their disease resistance, satisfactory yield and good market quality have partly replaced some of the older varieties in certain states

Based on the success of the potato breeding program thus far and on the skill and effort that is being put into this work there is good reason to believe that many more new and better varieties will be forthcoming in the next few years However as the potato breeding progrm progresses in its quest for the perfect potato the problems involved in the introduction of new varieties become more complicated. The potato breeder is faced with the problem of raising his standards to insure the superiority of his newest variety over varieties that are not quite so new The potato grower and the seed and table stock trade have the problem of determining the merits of the newest variety and deciding

[5]H C. Moore, State College, East Lansing, Mich.

which varieties to discard. It is believed that the potato breeder, the grower and the trade can be helped materially in their "new variety" problems if a well organized or standard procedure is used in introducing a new potato variety.

In this discussion no attempt has been made to summarize the procedures used by the various states in introducing new varieties Neither is it the intent to recommend procedures that would be applicable throughout the country Each state has its own soil and climatic problems, insect and disease pests, etc It is believed however that by outlining the work done in Michigan, that representatives here from other states will enter freely into the discussions. From their contributions no doubt some definite program of procedures can be worked out that will be of benefit to all concerned.

Only two varieties have been introduced from Michigan, the Pontiac and Menominee The Pontiac was first grown in 1931 from true seed furnished by the U S Department of Agriculture It was selected for further tests because of its vigorous plant growth, good yield and excellent tuber type For four years it was tested with other seedlings and with standard varieties at the Lake City Experiment Station The four years tests indicated that it had sufficient merit for over-state and out-of-state trials In 1936 peck samples were placed with 14 Michigan growers in representative potato growing sections of the state Ten tests were on upland soil and four on muck Peck samples of the seedling were also tested in five other states The results of the tests were generally satisfactory Most of the growers favored the seedling for its quick emergence and good stand, high yield, good type and freedom from hollow heart. On muck soil it was outstanding in yield Its tubers set deep so there was no sun burn injury. Further over-state and out-of-state trials were conducted in 1936, 1937, and 1938 with good results.

By 1936 it was believed that this seedling had sufficient merit to warrant putting it out as a new variety Therefore arrangements were made to increase it under inspection so that a reasonable amount of certified seed would be available when it was finally released as a new variety In Michigan the inspection and certification of seed potatoes is carried on by the Michigan Crop Improvement Association under the supervision of the Michigan State College. Several bushels of the seedling increased at the Lake City Experiment Station were placed with three certified seed growers—two in the lower peninsula and one in the upper peninsula. On the certified seed farms the seedling plots were isolated 200 yards or more from other potatoes and a portion of each

plot was planted in tuber units. Careful inspections and roguings were given the plots during the growing season. At harvest time hill and tuber unit selections were made for the next season's seed plots. Increases from the three certified seed farms amounted to approximately 2000 bushels in 1938. The name Pontiac was then given the seedling and it was released as a new variety.

The other Michigan release is the Menominee This U S.D A. seedling 528-118 was obtained from Maine in 1938 with other scab resistant seedlings. Common scab is a serious problem in Michigan and many other states. In Michigan many growers can not produce a good marketable crop of potatoes due to severe scab infection of the soil For the past ten years therefore special attention has been given to the breeding and testing of seedlings for scab resistance. The testing work has been carried on at the Upper Peninsula Experiment Station at Chatham, the Lake City Experiment Station and on a certified seed grower's farm at Rogers City. At each of these places the seedlings have been tested on soils heavily infested with scab Practically no scab-free potatoes have been produced on these plots with scab susceptible varieties such as Chippewa, Pontiac, Rurals, etc. For three years seedling 528-118 was tested with other scab resistant seedlings and proved the most scab resistant of any with one exception. Seedling 528-194 was slightly better in scab resistance but in cooking tests its flesh was dark. In 1941 seedling 528-118 was placed in over-state trials on 30 farms in tests with Russet Rural, Chippewa and other standard varieties The results of these tests showed that the seedling was worth considering for release as a new variety. Hill selections were made at the Rogers City farm for 1942 plantings and placed with two other certified growers. Field trials were continued in 1942 and 1943. Inspections and roguing were carried on at the three certified seed farms to insure a good supply of seed for distribution. Approximately 3000 bushels of certified seed were available in 1943 when the seedling was released for distribution as a new variety—Menominee.

Based on the experiences that we have had in Michigan in introducing new varieties the following suggested procedures might be made for our introduction of new varieties in the future. It may be that some of these suggestions will be applicable for other states.

1. When a seedling selection shows promise of becoming a new variety, increase it to 20 bushels or more in isolated plots under close supervision.

2. Test its adaptability to various soil and climatic conditions by placing one-half bushel or larger samples of it with a few selected growers in representative potato growing sections of the state.

3 Make two or more inspections of each grower's plot during the growing season to study disease and insect resistance, character of growth, adaptability, etc.

4 At harvest time obtain records of yield, type, freedom from disease, etc Procure samples for storage and cooking tests

5 If the first year's over-state tests are satisfactory continue them the second and third year on a larger scale.

6 If the seedling selection shows promise of becoming a new variety after one or two years of over-state tests, start two or more certified seed growers in its production. Each certified grower selected should be furnished with 10 bushels or more of the best seed available.

7 On the certified seed farms, plant the selected seed in isolated tuber-unit plots Supervise the roguing, harvesting and storing Make hill or tuber-unit selections for the next year's seed plot

8. Give the seedling a variety name and release it for distribution when assured of its merit and when there are several hundred bushels of it available for distribution

9 Govern the distribution of the new variety the first year through a Crop Improvement Association or other official state organization.

10 Publish in the American Potato Journal an article giving a technical description of the new variety· its adaptability, disease resistance, special cultural requirements, etc.

STEAM STERILIZATION TO KILL POTATO RING-ROT BACTERIA ON BURLAP BAGS

G. H. Starr

Wyoming Agricultural Experiment Station, Laramie, Wyo.

Burlap bags when contaminated with ring-rot bacteria, serve as a means of spread of the ring-rot disease from one lot of potatoes to another Steam sterilization has been recommended as a method to be used in this phase of ring-rot control.

Tests were devised during 1945 and continued in 1946 to determine how much sterilization was necessary to rid burlap bags of the causal bacteria.

Methods Used

In this study two quantities of bags were used,—one with 10-bag lots, put loosely in the autoclave and the other with 40-bag lots wrapped tightly with wire at each end of the bale. Previous to sterilization, a piece of burlap 6 inches square, contaminated with ring-rot bacteria.

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was placed in the center of each roll of bags. Immediately after sterilization, the roll of bags was removed from the autoclave and the contaminated burlap square was taken from the interior and tested for viability of the ring-rot organism This was accomplished by rubbing freshly-cut surfaces of 10 Bliss Triumph tubers over the burlap to pick up the bacteria. These seed pieces were later planted and the subsequent plants inspected several times during the growing season for disease symptoms.

In 1945 the following tests were conducted in duplicate 10-bag lots at both 5 and 10 pounds pressure for periods of 5 and 10 minutes, 40-bag lots at both 5 and 10 pounds pressure for periods of 5, 10, 20 and 30 minutes In 1946 the tests were similar except that the treatment periods were longer, the maximum being 45 minutes.

Results Obtained

In 1945 some of the treatment periods were too short to obtain the desired control. Thus, in 1946 some were omitted and a few longer treatments added. The accompanying table (1) shows the results for both years.

TABLE 1.—*Efficiency of steam sterilization for burlap bags as shown by the amount of ring rot resulting from the various tests conducted at* 5 *or* 10 *pounds pressure for periods of* 5 *to* 45 *minutes*

Burlap Bags, Pressure and Time of Sterilization			Per Cent Ring Rot (Gram-stain)	
No of Bags	Pounds Pressure	Minutes	1945	1946
10	5	5	45	—*
10	5	10	25	10
10	5	20	—*	5
10	5	30	—	0
10	5	45	—	0
10	10	5	50	—
10	10	10	45	15
10	10	20	—	0
10	10	30	—	0
10	10	45	—	0
40	5	5	35	—
40	5	10	55	45
40	5	20	20	15
40	5	30	0	0
40	5	45	—	0
40	10	5	50	—
40	10	10	55	40
40	10	20	—	0
40	10	30	0	0
40	10	45	—	0

*Tests not made that year

Table 1 shows that when 10 bags were autoclaved at 5 pounds pressure, a period of 20 to 30 minutes was necessary for complete sterilization, whereas at 10 pounds a 20-minute period was sufficient. When 40 tightly-rolled bags were treated similarly, a 30-minute period was necessary at 5 pounds and a 20-minute period necessary at 10 pounds for complete sterilization

Summary

Tests were made in 1945 and 1946 to determine how much sterilization was necessary to rid burlap bags, 100-pound size, of ring-rot bacteria

Both 10 and 40-bag lots were tested at 5 and 10-pound pressures for periods from 5 to 45 minutes In each case a contaminated burlap cloth was placed inside each roll and after sterilization it was used to inoculate cut surfaces of Bliss Triumph potatoes. These were planted later in field plots and the subsequent plants observed for ring rot.

The results indicated that the minimum requirements for thorough sterilization of 10 and 40-sack lots are as follows

10 bags (loosely rolled) at 5 pounds pressure—20-30 minutes
10 bags (loosely rolled) at 10 pounds pressure—20 minutes
40 bags (tightly rolled) at 5 pounds pressure—30 minutes
40 bags (tightly rolled) at 10 pounds pressure—20 minutes

SECTIONAL NOTES

ALABAMA

Harvesting of the commercial potato crop was finished about the 10th of June Final shipments, as had been forecast earlier in the season, amounted to about 3,000 cars This was 65 per cent of a normal crop for the acreages planted.

The price for U. S No. 1 grade averaged well above the floor price most of the shipping season On the other hand No. 1B size would not sell This resulted in the government support program, which received national publicity due to the dumping of some B size potatoes. Our growers, although not desiring to see waste, recall that a few years ago the OPA forced them to sell an entire crop for $2.00 per hundred less than could have been secured on the open market without control

As usual a certain per cent of our growers failed to make an adequate return on their investment and labor; whereas others realized a satisfactory return It seems that growers were better pleased with the Triumph variety, however the Sebago can be expected to hold its own

another season. Dusting and spraying proved to give satisfactory control of late blight according to observing growers. (July 9)—FRANK E. GARRETT.

CALIFORNIA

As of the 24th of June, 28,029 cars of potatoes have been shipped from the Kern district. Of this amount, 26,343 were from Kern County alone. This made 4,728 cars more than were shipped at this date last year. The peak day was the 28th of May with 956 cars loaded and shipped. The quality of the crop, on the average, is above last year. The yield per acre shows promises of being the highest in any year since the beginning of the industry. Our harvesting period, as a whole, is well past the peak, with many areas entirely completed.

One interesting fact, from the production and marketing reports, shows that to date 17,129 cars have been shipped from all other potato sections whereas 26,343 cars were loaded and shipped from Kern County alone.

Car shortage has curtailed digging and shipping for the past ten days, but is expected to improve in the near future.

The selling price declined gradually from the opening of $3 50 per 100 pounds, however, the price increased again to $3.25 which is our present selling price (June 27) —ROY M BARNES

COLORADO

Potato prospects in the San Luis Valley, better known as the Red McClure district, are very good. Growers finished planting early in June with the bulk of the acreage being planted in May. There was little rain at the beginning; however, by planting time soil moisture was very good.

Many plants had emerged in time to be frozen to the ground on the 19th of June. Later plantings that were not frozen are now ahead of some of the earlier plantings that were retarded in growth by the frost. The light showers and cool temperatures during the latter part of June and the first few days of July have been very favorable for potatoes (July 7).—W FRANK MCGEE

FLORIDA

The 1947 potato season at Hastings was one of the coldest, wettest and most unprofitable on record. The low temperatures on the 5th, 6th, 9th, 10th and 11th of February killed the tops of all our early-planted crops. About one-fourth of the acreage was seriously injured by the low temperatures. Approximately 1,000 acres in which 10 per cent or less

of the plants recovered were plowed up and replanted to potatoes and other crops

Heavy rains which totaled 6 to 8 inches in several localities during a 6-day period (April 12-17) 2 to 5 weeks before the crops were ready for digging caused extensive damage About 500 acres in one locality where 5.4 inches of rain fell within a 2-hour period were ruined completely A 50 per cent reduction in yield on at least 5,000 acres was caused by the deluge. Only approximately 1,000 acres of the 10,000 planted escaped damage from freezes, excessive water and soft rot. (July 7) —A H EDDINS

INDIANA

With the exception of the very last of June, the weather handicapped our potato growers to so great an extent that the acreage this year will be somewhat less than anticipated Those, however, who have potatoes planted have good stands, very little leafhopper or flea beetle, and very little blight

This week I visited our commission house in Lafayette and observed a lot of poor quality potatoes from the Western States and also from the South Some one is paying a lot of freight on cull potatoes, but I suppose the shippers are of the opinion—like most everyone else—that "anything will sell these days" (July 3) —W B. WARD

MAINE

This season our growers are two weeks late with their potato crop. Many farmers were unable to get a full day's planting until the very last of the season, because of showers Seldom has any one seen so much bare soil the first of July

Aroostook County had an allotment of 170,000 of the state's 185,000-acre total It is estimated that 95 per cent of the farmers are staying within their allotment and since most are playing safe, the total acreage for the county and state is estimated to be from 1 to 5 per cent under the allotment

Four meetings of former leaders were recently held with Floyd Hedlund, of the Fruit and Vegetable Division, who led the discussion on marketing agreements In view of the price situation however, no one seems to be particularly excited about marketing agreements at present There is little opposition also Whether much will be done toward marketing agreements for the 1947 crop remains a question.

E L Newdick, Chief of Plant Industry, announced that 65,449 acres have been entered for certification This is about 12,000 acres less than were entered last year Katahdins account for 33,760 acres; Cob-

blers dropped from 17,300 acres to 10,862; Green Mountains from 11,-100 to about 8,918; Chippewas increased to 8,320 from 6,685; and Sebagos dropped from 4,525 to 2,549 acres

Many farmers are using DDT for the control of flea beetles, and indications are that practically all farmers will use DDT every time they use fungicides Potato waste piles, which are usually a source of late blight infection, are being cleaned up (July 3).—VERNE C. BEVERLY

MICHIGAN

Michigan, like many other areas was somewhat delayed in getting the crop planted The weather has been very favorable since planting. Stands are generally good Some of the late plantings are just breaking through the ground

The acreage of certified seed will be 10 to 15 per cent below last year The largest part of Michigan's Seed acreage is Russet Rurals. This variety will comprise most of the reduction in acreage, whereas Katahdins will show some increase. Table stock acreage will be reduced with a very noticeable reduction with small growers

There is considerable interest in irrigation and a number of new irrigation projects have been set up .Most growers are using lakes, rivers, or ponds, as a source of water but a few have drilled wells. These are mostly 10-inch and are capable of supplying enough water for the irrigation of 75-100 acres with approximately 1 inch a week. (July 8.)—H. A. REILEY.

MISSOURI

Digging of the Missouri commercial potato crop began on the 8th of July and with favorable weather the bulk of the harvest will be completed by the 26th It is really too soon to give a very accurate estimate regarding yields per acre However, on the whole, the season has been none too favorable and the yields per acre are not expected to be as good as in 1946

Floods, back water and excessive rains during June destroyed approximately 50 per cent of the potato acreage in Jackson, in Ray and Clay counties The growers in these counties planted approximately 2,300 acres and the present estimate is that they will harvest about 1,200 acres. The acreage lost by the floods was in the Courtney and Atherton bottoms. This area generally produces the highest acre yields, whereas some of the remaining acreages, not destroyed by the floods, represent later plantings which are not expected to yield heavily (July 14).—ALLAN W PURDY.

NEW JERSEY

New Jersey growers have started to harvest their Cobblers although the vines are for the most part still green Yields have been fair to good General harvesting and car-lot shipments will start shortly after the 21st of July, with rather heavy movement in prospect about the 1st of August

Most potato sections have had sufficient rainfall for good plant growth to date and the prospects for a good yield are general.

Our growers have been urged to grade their potatoes with a 2" minimum and many growers are planning to do this in order to improve the pack

With orderly harvesting and shipping our growers should enjoy a good market during August and September with little need for government support (July 17) —J C CAMPBELL.

NEW YORK

This is the first time in many years that any appreciable acreage of potatoes has been planted after the 1st of July

Some fields that were planted early show a very uneven stand and in some areas excessive moisture has caused much seed piece rot Because of the lateness of the season and the high price of table stock, considerable seed was sold for table stock in April and May. These factors, coupled with a late spring and a labor shortage, will give a net result of considerably less acreage than last year for the up-state territory.

Our crop prospects are not so good because past experience indicates that late planting and poor stands usually result in a light crop. Potatoes do not seem to have the root system that they should have at this season of the year

To date we have heard of no blight in this general area but it has been reported on two sides of us It is only a matter of time before we can expect a general outbreak

Although much thought and attention are being given to proposed marketing agreements there seems to be very little actual interest on the part of the grower There is considerable interest however in putting up a better pack and following better merchandising methods on the part of some of our volume growers and associations (July 8) —H. J EVANS

NORTH DAKOTA

The condition of our North Dakota potato fields varies from good to excellent All variations caused by heavy rains and late plantings are being overcome during a season of good growing temperatures and ample

moisture. With the late June rainfall, ranging from 2 to 6 inches throughout the area of commercial production, our topsoil moisture is good and the subsoil moisture, in general, very good. The acreage is about 10 per cent below that of 1946.

Further improvement of the quality of table stock crop and safeguarding of the quality of certified seed are receiving widespread attention The following regulation of the State Seed Department has been well received and is resulting in an increase in the number of farmers who grow "nothing but certified"

"To be eligible for official field inspection and certification, all seed potatoes used on a farm or the farm-unit or with which the same planting and harvesting equipment and supplies were used must have passed field inspection requirements the previous year." (July 8).—HAROLD MATTSON

PENNSYLVANIA

Late blight was found on potatoes on the 2nd of July in Pennsylvania and by the 10th of July was present in at least six counties. In one instance it had spread from potatoes to tomatoes and was causing serious damage on both crops. The disease is starting early this year and growers are experiencing difficulty in getting sprayers through the fields because of the excessively wet weather that has prevailed in Pennsylvania this year (July 12).—O. D BURKE

SOUTH DAKOTA

Field inspection work is being conducted in the certified potato fields in South Dakota. The head field inspector, David Giese, reports exceptionally clean fields free from disease. The acreage entered for certification will total approximately 7,000 acres,—about the same as 1946 Bliss Triumphs comprise the bulk of the acreage although many Cobblers, Pontiacs and Red Warbas have been planted this year.

A hearing on a proposed marketing agreement for South Dakota was held in Watertown on the 19th and 20th of June. A referendum will be held soon to vote on the proposition. Growers are enthusiastic over the prospect of a favorable season this year but they do not anticipate the record yields presented last year because of the lateness of the season (July 9) —JOHN NOONAN.

UTAH

The potato crop looks good in all the principal potato-growing areas. This is due largely to the cool, moist weather that prevailed during May and June. Harvesting of the early crop was begun in Weber County

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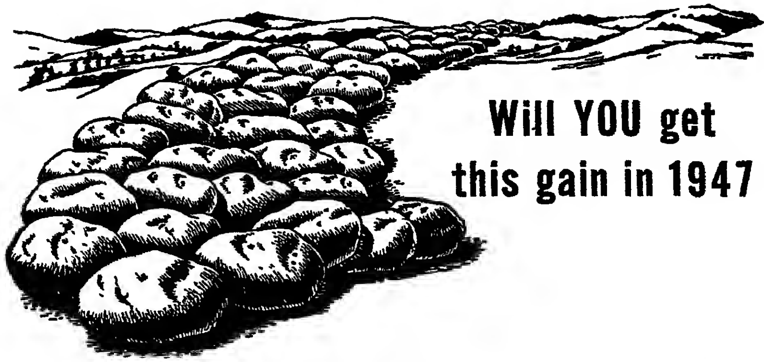

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on the 25th of June and will continue throughout July and most of August.

The 1947 acreage is estimated to be about 6,150 acres of commercial stock and nearly 1,200 acres of seed. All potato-producing areas in the state, except Iron County, have reduced their acreage from 10 to 20 per cent In contrast with Iron County, Cache Valley planted only approximately 325 acres of their 762-acre allotment.

The bulk of the acreage is devoted to the Bliss Triumph, Netted Gem and White Rose varieties In Box Elder and Weber Counties there is also an appreciable acreage of Irish Cobbler, Katahdin and Pontiac varieties There is an increased acreage of Pontiacs this year, supplanting Bliss Triumph and Cobbler. The growers report that the Pontiacs appear to be less perishable than the Cobbler and their eating quality surpasses that of the Bliss Triumph

The acreage of certified seed is slightly less than in 1946. Applications for 1,182 acres have been filed, as compared with 1,213 acres certified in 1946. The acreage of White Rose is nearly 13 per cent higher than last year, whereas that of Netted Gem is about 10 per cent lower, with Bliss Triumph approximately 30 per cent lower than 1946.

The unusual occurrence of leaf roll in the Utah foundation seed stocks of the Bliss Triumph variety in recent years has necessitated the initiation of research in improved methods of indexing and propagating foundation stocks. (July 1) —E. L. WALDEE

VIRGINIA

The potato crop is being harvested about two weeks later than usual this year. The crop was delayed by dry weather during May and June The general yield will be somewhat below normal and serious reductions will be experienced in some parts of the Eastern Shore area

Late blight was of no importance in 1947 None was found on the Eastern Shore and only a trace was found in the Norfolk area. Black leg was more prevalent than usual and is causing some rot in the field and in transit. The potatoes are generally of good quality, but some rot is developing in transit as a result of sun scald. (July 9) —HAROLD T COOK

MEETINGS OF INTEREST TO POTATO GROWERS

August 7—Richford, New York Annual field day of the Empire State Potato Club on the Clark Seed Farms There will be demonstrations of mechanical stone pickers, new types of

diggers, airplane and helicopter dusting, flame weed and vine killers An attendance of 20,000 is expected.

August 12—Monte Vista, Colorado. Eighth annual field day at the San Luis Valley Demonstration and Experimental Farm.

August 15-16—Monte Vista, Colorado The High Plains Potato Conference will be held at the El Monte Hotel The first day will be devoted to a discussion of potato problems A field trip and various demonstrations have been arranged for the second day, followed by a picnic Reservations may be made direct to the El Monte Hotel, El Campo Tourist Court, or the Triangle Cottage Camp.

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NEW BRUNSWICK, N J

NEW VARIETIES OF POTATOES

F. J STEVENSON

A Committee Report to the Potato Association of America

There have been a number of requests from members of the Potato Association of America for a report on the present status of the new potato varieties In response to these requests, Mr E B Tussing. President of the Association, appointed a committee[1] to assemble data concerning these varieties Each member of the committee was appointed to represent a geographic section of the United States and one to represent Canada. All except two members of this committee have sent in reports, and an attempt has been made to summarize the findings.

Since 1932 at least 34 new varieties have been distributed to growers in the United States. Some of these have increased very rapidly, others have increased more slowly, a few have fallen by the wayside. and others are so new that they have not yet appeared on the certified seed-potato lists The new varieties released to growers since

[1]The members of the committee and the sections of the United States and Canada they were to report are
W C Libby, University of Maine, Orono, Maine — New England States
J C Campbell N J Agr Exp Sta New Brunswick, N J — Middle Atlantic States
J. P Sleesman, Ohio Agr Exp Sta. Wooster. Ohio — East Central States
E L LeClerg, University of Louisiana, Baton Rouge, La — Southern States.
F A Krantz, University of Minnesota, University Farm, St Paul, Minn — North Central States
W. A Riedl, University of Wyo, Laramie, Wyo — Mountain States.
Glen N Davis, Cal Agr Exp Sta, Davis, Cal — Pacific States
L C Young, Experiment Station, Fredericton, N B, Canada — Canada
F J Stevenson, Chairman, U S Dept of Agr. Plant Industry Station, Beltsville, Md

TABLE 1 —*New varieties of potatoes released in the United States since 1932.*

Variety	Cooperating State	Original Number	Year Released	Maturity	Tuber Shape[1]	Depth of Eye[2]	Skin Color[3]	Flesh Color[4]	Disease Reaction[5]									Specific Gravity[6]	Certified Seed in United States in 1946	States with Certified Seed
									Mild Mosaic	Leafroll	Net Necrosis	Yellow Dwarf	Late Blight Vines	Late Blight Tubers	Scab	Ring Rot	Brown Rot		Bushels	
Ashworth[7]	N Y	N Y. ECU-1	1946	L	—	—	—	—		—	—	—	I	—	—	—	—			
Calrose	Cal	USDA 672-26	1946	L	el-ob	sh	W	Y	R	—	—	—	MR	—	—	—	—	1 078	340,000	Cal.
Cayuga	N Y.	USDA 627-126	1946	L	el	sh	Rus	W	S	—	—	—	—	—	HI	—	—	1 096		. .
Chenango[7]	N Y.	N Y CUI-2	1946	M	—	—	—	—		—	—	—	I	—	—	—	—	1.067		.
Chippewa	Maine	USDA 42672	1933	M	el-ob	sh	W	W	FI	VS	I	S	S	S	VS	S	—	1 080	1,799,378	11 States
DeSoto	La	La TK-3-39-14	1944	M	el-r	m	R	W	R	S	—	—	—	—	—	—	—	1 076	6,670	S Dak
Earlaine	Maine	USDA 45075	1937	E	r	msh	W	W	FI	S	R[8]	—	S	S	S	S	—	1 079	.	. .
Earlaine No. 2	Maine	..	1938	L	r	msh	W	W	—	S	R[8]	—	S	S	S	S	—	1 075		.
Empire[7]	N Y	N Y CRH-7	1945	L	ob	sh	W	W	—	—	—	—	I	—	—	—	—	1.072	760	N Y
Erie	Ohio	USDA 47101	1942	L	r	msh	W	W	S	S	—	—	S	S	S	—	—	1 087	32,450	Mich , N Y , Ohio, Wis
Essex	N. Y.	N Y DAB-3	1946	E	—	—	W	W	—	—	—	—	I	—	—	—	—			. .
Golden	Maine	USDA 44428	1933	L	r	msh	W	Y	—	S	—	—	S	S	MR	S	—	....	....	.
Houma	La	USDA 44639	1936	L	r	msh	W	W	FI	MR	HR	—	VS	S	S	S	—	1 088	68,703	Me , N H , N.Y., Pa , Vt.
Kasota	Nebr & Minn	Minn 1 33-1-34	1943	L	br	sh	R	W	—	S	—	—	S	—	S	—	—	1 085	16,933	Mont , Nebr., Wyom
Katahdin	Maine	USDA 42667	1932	L	el-r	sh	W	W	FI	MR	I	S	S	S	S	S	MR	1 093	8,303,035	17 States
LaSalle	La.	La Ch x T(3-1) 1-66	1944	M	el-r	m	W	W	R	S	—	—	—	—	—	—	—	1 087	5,400	S. Dak.
Marygold	Md	USDA 47148	1946	L	el-r	msh	W	Y	—	—	—	—	—	—	—	—	—	1 088		.
Menominee	Mich	USDA 528-118	1944	L	r	msh	W	W	MR	S	—	—	MR	MR	HR		—	1 077	57,353	5 States
Mesaba	Iowa & Minn	Minn 35-26	1938	E	r	sh	W	W	—	—	S	—	S	S	S	S S	—	1 089	.	.
Mohawk	N Y.	USDA 46000	1943	L	ob	sh	W	W	FI	S	S	—	S	S	S	S	—	1 103	29,697	Maine, Minn , N Y
Norkota	N Dak	USDA 46019		L	el-ob	sh	W	W	—	—	—	—	—	—	—	—	—		.	.
Ontario	N Y.	USDA 528-242	1946	L	ob	sh	W	W	—	S	—	—	—	—	HR	—	—	1 088	13,300	N Y.
Pawnee	Colo	Colo 1608	1942	M	el-r	sh	W	W	—	S	—	—	S	S	VS	—	—	1 088	1,183	. .
Placid[7]	N Y.	N Y DAC-1	1946	L	or-ob	msh	W	W	—	—	—	—	I	—	—	—	—	1 003	760	N. Y.
Pontiac	Mich	USDA 401-23	1938	L	r-ob	msh	R	W	S	S	R[8]	—	S	S	S	S	—	1 083	421,207	13 States

Variety	Cooperating State	Original Number	Year Released	Maturity	Tuber Shape[1]	Depth of Eye[2]	Skin Color[3]	Flesh Color[4]	Disease Reaction[5]: Mild Mosaic	Leafroll	Net Necrosis	Yellow Dwarf	Late Blight: Vines	Late Blight: Tubers	Scab	Ring Rot	Brown Rot	Specific Gravity[6]	Certified Seed in United States in 1946	States with Certified Seed
Potomac	Md	USDA B-247	1943	L	el-r	msh	W	W	—	S	—	—	MR	MR	—	—	—	1 087	268	Md
Red Warba	Minn	Minn mutant	1939	E	rb	d	R	W	FI	S	—	—	S	S	S	S	—	1 088	337,983	5 States
Russet Sebago	Wis	Sport of Sebago	1944	L	rel	sh	Rus	W	—	—	—	—	—	—	—	—	—		1,200	Wis
Sebago	Maine	USDA 44488	1938	L	el-rel	sh	W	W	FI	S	MR	HR	MR	MR	MR	S	MR	1 093	1,619,098	15 States
Seneca	N Y	USDA 627-235	1946	L	r-ob	msh	Rus	W	S	—	—	—	—	—	HR	—	—	1 092		
Sequoia[9]	N C	N C 130 5-24	1939	L	el-ob	sh	W	W	—	S	S	—	MR	VS	S	S	—	1 090	97,140	11 States
Teton[7]	Wyom & Maine	USDA 47102	1946	L	1-ob	sh	W	W	R	S	—	—	—	—	—	HR	—	1 088	8,245	Pa , Wyo
Virgil[7]	N Y	N Y CYJ-1	1946	L	ov	d	W	W	—	—	—	I	—	—	—	—	—	1 082		
Warba	Minn	Minn 51-16	1933	E	rb	d	WP	W	FI	S	—	—	S	S	S	S	—	1 086	40 441	5 States

[1]Shape of Tuber:
- br=broadly roundish
- el=elliptical
- ob=oblong
- ov=oval
- r=round or roundish
- rb=round blocky
- rel=round elliptical

[2]Depth of Eyes:
- d=deep
- m=medium
- msh=medium shallow
- sh=shallow

[3]Color of Skin As Considered in the Trade:
- R=red
- Rus=russet
- W=white
- WP=white with pink eyes

[4]Color of Flesh:
- W=white
- Y=yellow

[5]Disease Reactions:
- FI=field immune
- HR=highly resistant
- I=immune from common race
- MR=moderately resistant
- S=susceptible
- VS=very susceptible

[6]Relative Densities	Starch Equivalent
1 060	9 5
1 065	10 7
1 070	11 7
1 075	12 9
1 080	13 9
1 085	14 9
1 090	16 1
1 095	17 2
1 100	18 2
1 105	19 3

[7]Data taken from the *Potato World*, Jan 1946

[8]In preliminary tests

[9]Resistant to hopperburn and flea beetle injury

1932 are listed in table 1 In this table are given the state or states that distributed the variety, the original number of the seedling, the year it was released, and data on a number of characters The data for disease reaction are not complete, because the newer varieties were tested for the principal character for which they were released but not for all other characters

If one is to judge by the amounts of seed certified in 1946, Katahdin with 8,303,035 bushels of certified seed, Chippewa with 1,799,378 bushels and Sebago with 1,619,098 bushels are the most widely grown of the new varieties In fact, there was more certified seed of Katahdin in 1946 than of any other late variety It was surpassed only by the Irish Cobbler During the same season the Maritime Provinces of Canada produced 2,424,779 bushels of certified seed of Katahdin; 1,601,557 bushels of Sebago, and 6,720 bushels of Chippewa In the United States these three varieties were followed by Pontiac with 421,207 bushels of certified seed, Calrose with 340,000 bushels, and Red Warba with 337,983 bushels

Northeastern States

The report for New England, as sent in by W C Libby, Head of the Department of Agronomy, University of Maine, shows that there are six new varieties grown in New England at present Katahdin, Chippewa, Sebago, Houma, Sequoia, and Mohawk. The production data for these varieties are given in table 2 According to the estimates, 51 per cent of the total production in New England consisted of these six varieties

Table 2—*The production of new potato varieties in New England in 1945*

Name of Variety	Production	Estimated Production	Production
	Acres	Bushels	Per cent
Katahdin	74,375	19,412,850	30 2
Chippewa	21,980	5,277,800	8 2
Sebago	22,450	5,991,320	9 3
Houma	6,770	1,560,000	2 4
Sequoia	1,800	397,000	6
Mohawk (Maine only)	less than 500	less than 150,000	less than 3
Total	127,875	32,788,970	51 0

The Katahdin has replaced, to some extent, the Green Mountain and the Irish Cobbler because of its higher market quality due to its

freedom from net necrosis and because it is easy to grow and keep reasonably free from diseases

The Chippewa is grown instead of the Green Mountain in some sections because of its earliness and its freedom from net necrosis and stem-end browning The Sebago is also competing with Green Mountain because of its blight resistance and freedom from internal discoloration that is so often found in Green Mountain. Houma is preferred by some growers because of its resistance to internal discoloration Sequoia is on the increase because of high yields and freedom from net necrosis. The Mohawk is just going into production in Maine, but those who have grown it like not only its high market and cooking quality but also its resistance to mild mosaic When this variety was first under test at Aroostook Farm, no net necrosis was found in it, later it developed this disease, but perhaps not to the degree that is often found in Green Mountain If it were not for the net necrosis found in Mohawk it would replace the remaining Green Mountains almost entirely

Middle Atlantic States

A survey of the Middle Atlantic States which was made by J C Campbell of the New Jersey Agricultural Experiment Station, New Brunswick, New Jersey, shows that nine new varieties are grown in that section. Chippewa, Earlaine No 2, Houma, Katahdin, Mohawk, Pontiac, Sebago, Sequoia, and Warba About 44 per cent of the potatoes grown in New Jersey, nearly 25 per cent of those in the state of New York, and 75 per cent of those in Northampton and Lehigh counties of Pennsylvania are Katahdins A few Katahdins are also grown in Virginia and Maryland

The Chippewa is second among the new varieties in this section Ten to fifteen per cent of the potatoes grown in New Jersey, 7 per cent of those in New York State, and a few of those in Pennsylvania, Maryland, and Virginia are Chippewas

The Sebago is grown to some extent in all the states in this section but especially in New York and Pennsylvania About 12 per cent of the certified seed grown in New York State, 10 per cent of all potatoes in western and central New York, 13 per cent of those in Erie County and approximately 50 per cent of those in Courtland County are Sebagos. About 15 per cent of the potatoes grown in Pennsylvania are Sebagos The production areas of this variety are scattered throughout the state with the most concentrated area in Lehigh county The Sebago does not compete with Katahdin and Chippewa in New Jersey and as a result only about 2 per cent of the production in that state is of this

variety The Sebago has been found suitable for a fall crop in the lower piedmont and the tidewater sections of southeastern Virginia and last year about 250,000 bushels of this variety were grown there A few thousand bushels are also grown in Delaware and Maryland

Houma is found, for the most part, in central New York where approximately 1,000,000 bushels are grown, mostly in Erie and Courtland counties About 1 per cent of the certified seed in New York State is Houma

Sequoia has made a slow but steady increase. About 3,100 acres of this variety were reported in this section, divided as follows Virginia, 1,200 acres, Maryland, 750, Delaware, 150, western and central New York, 500, and New Jersey, 500, with a total production varying between 6 and 8 million bushels

East Central States

Kentucky

In Jefferson County, Kentucky, Irish Cobbler has been the main-crop variety for years As new varieties were introduced they were compared with Irish Cobbler, and if they did not compare favorably with this variety during a 3-year period they were discarded, so, in turn, came White Gold, Golden, Warba, Houma All were tried and dropped. Then came Katahdin, which was kept, but only as a late crop since it invariably outyielded second-crop Cobblers Chippewa is not popular with consumers because of its poor cooking quality; a small acreage of this variety is grown for chip manufacture Sebago is definitely not suited for a first-crop potato and it may be too late for a second-crop variety Sequoia is here to stay; it is expected to displace Irish Cobbler because it has consistently outyielded this variety and the tubers are more shapely Warba is on the way out. Its chief weaknesses are that it sets too heavy, produces too many culls, and the market does not like the pink eye.

Indiana

Katahdin is the leading medium-late variety, replacing Rural and Irish Cobbler and accounting for 45 per cent of total production This is a high-yielding variety but it is susceptible to leafhopper and flea beetle injury. Its tubers are well shaped The keeping quality is good and there is a good market demand

Chippewa, an early-maturing high-yielding variety, accounts for 32 per cent of the total production, replacing Irish Cobbler. It produces smooth, shallow-eyed tubers having good market quality, and the mar-

ket demand is good Its chief weaknesses are a thick skin, poor keeping quality, and susceptibility to scab, leafroll, leafhoppers, flea beetles, and late blight both in the vines and the tubers

Sebago makes up 4 per cent of the total production, replacing Rurals It is a late high-yielding variety Its tubers have good market appearance and the market demand is good Both the cooking quality and keeping quality are good It is resistant to scab and to late blight in the tubers and in the vines, and is susceptible to flea beetles and to leafhoppers

Pontiac is a late high-yielding red variety with large, rough tubers, showing poor market quality and poor demand. Very few are grown in Indiana

Sequoia is a very high-yielding late variety, with cooking quality poor to medium, and tubers large and coarse It is susceptible to scab and to late blight rot in the tubers, and resistant to the potato flea beetle and the leafhopper

Red Warba is an early-maturing variety that is susceptible to scab and leafhoppers Very few are grown because of the small rough deep-eyed tubers

West Virginia

Sebago, Katahdin, and Chippewa account for 20, 10, and 5 per cent, respectively, of the total production of potatoes in the state Sebago has replaced the Rural Its tubers have good market appearance and are resistant to soil rots and to late blight Katahdin has replaced some of the Rurals. It is resistant to virus diseases and develops good-looking tubers Chippewa has replaced the Irish Cobbler because of its smoother tuber

Menominee is just being introduced It yields well, stores well, and shows promise Mohawk was discarded because the tubers were of an undesirable type, did not store well, and were susceptible to ring rot

Houma shows some resistance to heat It is grown very little Erie is not grown It was discarded because it lacked outstanding characteristics as compared with other new varieties Pontiac is not grown, but in tests it appeared to be well adapted to intermediate and higher altitudes It is a high yielder and vigorous, but very susceptible to scab. Its color is not desirable in West Virginia

Potomac is well adapted and is promising for home and farm gardens where little attention is paid to pest control It is less susceptible to soil rots than Sequoia

Illinois

Pontiac is a high-yielding red variety of medium late maturity It is resistant to dry hot weather Very few are grown in the state.

Sequoia is a high-yielding, late variety. Its tubers are large with good market demand and good keeping quality The cooking quality is medium. The incidence of hollow heart is high It is resistant to hopperburn. Not many are grown in the state. Katahdin accounts for 8 per cent of the total production, replacing the Rural Chippewa represents about 1.2 per cent of the total production and Sebago 1.4.

Nebraska

Kasota accounts for 5 per cent of the total production, replacing Cobbler and Katahdin. It is a high-yielding medium late variety Its tubers have good market, cooking, and keeping qualities It is susceptible to leafroll, spindle tuber, blackleg, flea beetles, aphids, and psyllids This variety is resistant to Fusarium wilt and stem-end browning

Ohio

Katahdin is the leading late variety grown in Ohio It is widely adapted, largely replacing Russet Rural It accounts for 40 per cent of the total production It is well adapted to the heavy limestone soils of western Ohio It holds its shape in drought seasons, is affected less with scab than is Irish Cobbler, and because of its white skin is preferred to Russet Rural on the market Its big weakness is a light set of tubers and the tendency of the resulting large tubers to protrude from the soil. Moderate hilling is necessary to prevent sunburning. It is susceptible to flea beetle injury and hopperburn.

Sebago is grown on 3 per cent of the acreage, replacing Russet Rural Its weaknesses are. sprouts early in storage, susceptible to the leafhopper, has considerable purple top disease

Chippewa is grown in a small way, mostly on muck soil. Its weaknesses are poor stands, considerable leafroll, and tuber wounds often fail to heal which results in considerable rotting in storage.

Warba is a high-yielding variety when grown under favorable conditions. It sets heavy, with too many small tubers as a result Pawnee, Mesaba, and Earlaine give low yields in comparison with those for Cobbler

Houma does not stand the heat well and the tubers often are off-shape.

Sequoia is a late high-yielding variety producing rather coarse tubers with a strong flavor If spacing between hills in the row is re-

duced to about 8 inches the tubers will be smaller and smoother Sequoia is resistant to hopperburn

Potomac is similar to Sequoia in most respects. It too shows considerable resistance to hopperburn

Pontiac is highly susceptible to hopperburn. It yields well, when carefully sprayed, but is late-maturing The tubers are large and the red color tends to fade out

Mohawk is a late variety and the tubers are usually off-shape It is not adapted to Ohio

Erie produces a good yield of round, nice-looking tubers It tends to set too many tubers and there have been several reports of internal browning

Menominee is a late high-yielding variety, resistant to scab and to hopperburn It is not likely to find a place in commercial production in Ohio because of its lateness; and, more important, the tubers are deep-eyed and very coarse.

Southern States

In some areas of the southern states during the past 5 to 8 years many of the newer varieties of Irish potatoes have displaced older ones, and in other areas they are increasing rapidly in popularity. In some locations late-maturing varieties that are resistant to late blight are being grown instead of early-maturing varieties.

For years southern Alabama has grown early-maturing Triumph, but during the past two years has turned to Sebago, and in 1946 the indications were that about 40 per cent of the total potato acreage would be planted to this variety

The Homestead area (Dade County) of Florida has been planted for years to Triumph In 1941 a small acreage of Sebago was planted because of its resistance to late blight. Two years later, because of its red color, the Pontiac variety made up about 5 per cent of the total acreage, and this variety has increased in popularity until in 1945 approximately 55 per cent of the 6,000 acres of potatoes was in Pontiac.

In the Hastings, Florida, area the growers abandoned the growing of the Spaulding Rose variety, and by 1941 they were planting about 95 per cent of the acreage to Katahdin, Earlaine, Sebago, and Pontiac. By 1943 the growers almost unanimously preferred Katahdin or Sebago and planted about 95 per cent of the acreage to these varieties, with Sebago occupying first place, on about 60 per cent of the potato land In 1944 about 65 per cent of the total potato acreage was planted to Sebago, about 28 per cent to Katahdin, about 2 per cent to Pontiac, and a small amount to Sequoia. The acreage in Sebago continued to in-

crease, and in 1946 about 80 per cent of the potato crop in this area was Sebago. Katahdin, on the other hand, dropped from about 28 per cent to approximately 15 per cent Pontiac, however, showed some increase, from 2 to approximately 4 per cent.

In central and northern Louisiana the Katahdin variety is being grown to a considerable extent. It is very satisfactory for chips according to manufacturers in the state Because of its good keeping quality it can be held in sweet potato storage houses during the summer until August or September and then bring a premium price on the market

In eastern North Carolina the Red Warba variety yields well, but has not displaced to any marked degree the Irish Cobbler. The Sequoia variety has become well established in the more mountainous area of the western part of the state

The acreage of Irish Cobbler in South Carolina was reduced from about 65 per cent of the total crop in 1943 to approximately 35 per cent in 1944, having been replaced by the new varieties Katahdin and Pontiac About 5 per cent of the potato acreage in 1944 was Sebago. These varieties are continuing to grow in popularity

In Tennessee the Sequoia variety has steadily increased in production on the Cumberland Plateau Pontiac also yields well in this area Much of the acreage in 1945, however, was planted to Sequoia

North Central States

The data from F A. Krantz included a report from H C. Moore of the Michigan State College on all the varieties grown commercially in Michigan; a report of two new varieties in the peat beds of northern Iowa, a list of the varieties with their advantages and disadvantages that are grown commercially in North Dakota, compiled by Harold Mattson of the North Dakota Agricultural College, a similar list for Wisconsin by H M Darling and G H Rieman of the University of Wisconsin, and a list for Minnesota by F. A Krantz.

Michigan

The Russet Rural is the leading variety in Michigan, accounting for nearly 65 per cent of the crop It is widely distributed throughout the state except in two or three of the Lake Superior counties It has some degree of resistance to drought and scab The tubers have fair market and cooking quality when properly grown The chief defects of this variety are its susceptibility to hollow heart, off-type tubers under drought conditions, and darkness of skin when not mature. For these reasons it is being replaced in some localities, particularly in the Grand Rapids area, by the Chippewa

The Chippewa constitutes about 10 per cent of the potato crop. It is grown chiefly in the central Lower Peninsula and in scattered counties throughout the lower area. In recent years it has also gained some popularity in the counties of the Upper Peninsula. It seldom grows hollow, has a bright skin, is preferred on most markets to Russet Rural, and can be grown either as a medium early or medium late potato. Its drawbacks are its susceptibility to scab and its tendency to bruise. It requires very careful handling in storage and seed treating. It is particularly sensitive to low temperatures and sometimes develops a mahogany red color of flesh.

The Katahdin variety has not been very popular among most of the growers but only a few are much interested in it. In some ways the Katahdin is superior to the Chippewa. The main objections to the Katahdin are its tendency to set shallow, resulting in sunburned tubers, its susceptibility to hollow heart, and its light set.

The Pontiac has gained in popularity very slowly. Growers like it because it sprouts early in the season, comes up quickly, and gives a good uniform stand of plants. It grows fast and yields very well. A good demand for it for seed purposes seems to exist in Florida and other southern states. In Michigan it seldom grows hollow. It is a good keeper and does not rot easily in wet soil or even when affected with late blight. It is very susceptible to scab and to air checking. Last year in the northeastern area of the Lower Peninsula Pontiacs suffered severe injury from air checking.

The Green Mountain has been grown in Michigan particularly in four or five of the counties on Lake Superior, for a long time. Its cooking quality is generally good. The yields are high when the variety is grown on good soil under favorable climatic conditions. It is quite susceptible to virus diseases, particularly mosaic.

The production of the Sebago variety has been limited to very few acres. So far it looks quite promising and seems to survive dry weather periods very well and holds its type. It is highly resistant to the deep scab and moderately resistant to late blight, but it is more susceptible than most of our other varieties to black leg, and was severely affected this past season. Its market and cooking qualities are very good. It should do very well in Michigan.

The Erie is a new variety that was developed by the Ohio Agricultural Experiment Station. For the past two or three seasons it has been grown for the Ohio seed trade by 8 or 10 seed growers in the Gaylord-Elmira areas of Michigan. It yields quite well on the light soils and seems to withstand drought. Some growers claim that it does

not scab as much as Chippewa and other white-skinned varieties. Apparently a number of the Ohio growers prefer this variety to others. At least, they are insistent that Michigan growers produce seed for them.

The Menominee is a variety that was developed about 3 years ago by the Michigan Agricultural Experiment Station in cooperation with the United States Department of Agriculture. It is very late and tends to set light The skin is often flaky with a slightly rusty appearance It produces large tubers that generally are quite deep-eyed, especially at the seed end. It has developed some hollow heart in a few locations in Michigan It compares favorably in yield with Russet Rural and other late varieties. It has considerable scab resistance—more than Sebago, and it has shown more late blight resistance than Sebago Menominee is recommended particularly for growers who cannot produce ordinary varieties because of badly scab-infested soils. Several hundred acres of this variety are in production in Michigan Its popularity no doubt will wane quickly when an earlier variety can be found that has the same degree of scab resistance.

The White Rural has been practically replaced in Michigan by the Russet Rural, but a limited number of growers are still producing it. What has been said concerning the Russet Rural will apply to the White Rural except that it might be preferred on some markets because of its whiter skin. It is not quite so resistant to scab as Russet Rural, or perhaps the scab is more easily discernible on the White Rural.

The Irish Cobbler is grown to some extent on muck and sandy loam soil, especially in the market areas of southern Michigan. It has recently been largely replaced on muck soil by the Chippewa The Chippewa will outyield the Cobbler by 40 bushels or more to the acre. It seems to produce potatoes as large as Cobblers in about the same length of time, although it is a later variety than the Cobbler. Nearly every one of the few thousand bushels of certified seed of Irish Cobbler are produced in the Bay City area in Midland County Bay County produces several thousand acres of Irish Cobbler for table stock. This is probably the most concentrated area of Cobbler production in Michigan.

The Russet Burbank is grown in Michigan on a very limited acreage The main difficulty with Russet Burbank is that the variety requires a soil of high fertility, and the weather conditions in Michigan are not suitable so it often produces potatoes of small size However, a few growers produce the Russet Burbank successfully, but the variety is of no commercial importance in Michigan.

Northern Iowa

C L. Fitch reported that about 40 acres of Sebago were grown on the peat beds of northern Iowa in 1945 The estimated production was 8,000 sacks. The variety is on trial in the state because of its scab resistance. It may replace the Irish Cobbler on the worst-scabbing land. The Menominee is also under trial for the same conditions.

North Dakota

The varieties Triumph, Irish Cobbler, and Early Ohio account for 90 per cent of the potatoes grown in North Dakota—45, 35, and 10 per cent, respectively Only 9 per cent of the crop consists of new varieties—Chippewa, 3 per cent; Katahdin, 2; Pontiac, 2, Warba, 1, Red Warba, 0 5; and Sebago, 0.5 per cent. The remaining 1 per cent is White Rose.

Wisconsin

Of the total potato acreage in Wisconsin, the varieties grown and the order of their importance are Russet Rural, 28 per cent; Chippewa, 24, Irish Cobbler, 23; Rural New Yorker, 8, Katahdin, 6, Sebago, 5; Triumph, 2, Pontiac, 1; and Sequoia, 1 per cent. In seed production, Chippewa comes first with 26 per cent, Irish Cobbler, 18, Russet Rural, 14, Triumph, Katahdin, and Sebago, 12 per cent each; and Rural New Yorker and Sequoia, 2 per cent each The advantages of Chippewa were given as high yield and high table and market quality. Its disadvantages were susceptibility to scab and late blight The Sebago has fair resistance to late blight and yellow dwarf but is late-maturing and variable in tuber set.

Minnesota

The two leading varieties in Minnesota are Irish Cobbler which represents 68 per cent of the total production and 53 per cent of the seed production, and Triumph with 8 per cent of the total and 23 per cent of the seed Of the total production, the new varieties in the order of their importance are Chippewa, 10 per cent of the total and 3 of the seed; Red Warba, 1 per cent of the total, about 6 of the seed, Pontiac, 1 per cent of total, 4 of seed; Warba, 1 per cent of total and nearly 2 of seed; Sequoia, 1 per cent of total but less than 1 per cent of the seed. Other new varieties grown, each of which represents less than 1 per cent of the total production, are Mesaba, White Gold, Kasota, Pawnee, Katahdin, and Sebago.

Mountain States

Five new varieties are grown commercially in Wyoming, but not to a very large extent. Table 3 gives these varieties and the production of each in 1945

Table 3.—*Potato varieties grown in Wyoming and the estimated production of each in 1945*

Variety	Estimated Acreage	Estimated Production
	Acres	Bushels
Katahdin	50	10,000
Pontiac	7	2,500
Teton	22	5,000
Red Warba	125	25,000
Kasota	15	5,370

Because of its higher yielding ability and its resistance to ring rot, the Teton will probably replace the Irish Cobbler and the Katahdin in Wyoming.

In Utah the new varieties Katahdin, Chippewa, Pawnee, and Pontiac are being tried out.

The Kathadin and Chippewa are replacing the Irish Cobbler not because of similar maturity but only as other varieties to grow, since it is too difficult to grow clean Cobbler seed The Pawnee is just being tried out. The Pontiac may replace Bliss Triumph, especially on dry lands, then, too, it is heat- and drought-resistant.

THE DIFFERENTIAL RESPONSE OF POTATO VARIETIES TO SPRAYING WITH DDT PLUS A FIXED COPPER

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Various investigators have shown that many of the commonly grown potatoes differ considerably in their susceptibility to injury by various insects and diseases (1,2) Sleesman and Bushnell (3) found a variation in the response of different varieties to the application of Bordeaux mixture Potato spraying experiments conducted in Ohio in 1945 (4) indicated that not all varieties responded in the same way to the application of DDT. With this in mind it was decided to compare a number of varieties that varied considerably in their susceptibility to injury by disease and insect attacks

Ten varieties that cover approximately the maximum range in ma-

TABLE 1.—*The influence of spraying with COC-S + DDT on the yield, defoliation, leafhopper population and flea beetle punctures of 10 potato varieties grown at Wooster in 1946.*

Variety	Yield in Bushels per Acre		Increase Due to Spraying		Per cent of Foliage Dead on Aug 17		Leafhopper Nymphs per 100 Leaves on July 15		Flea Beetle Holes per 1.5 cm disc on July 15	
	Unsprayed	Sprayed	Bushels	Per cent	Unsprayed	Sprayed	Unsprayed	Sprayed	Unsprayed	Sprayed
Warba	126	334	208	164	100	95	38	0	19	0.2
Bliss Triumph	163	406	243	149	100	70	68	0	17	1.5
Irish Cobbler	254	472	218	86	97	80	14	0	16	0.0
Katahdin	215	464	249	116	80	20	9	0	13	0.5
Chippewa	231	456	225	97	97	37	7	0	14	0.2
Pontiac	275	583	306	112	77	22	27	0	11	0.1
Sebago	276	513	237	86	45	15	5	0	8	0.3
Erie	318	590	272	86	70	25	1	0	10	0.3
Russet Rural	231	465	234	101	70	17	1	0	10	0.2
Sequoia	261	540	279	107	30	7	0	0	8	0.0
Averages	235	482	247	105	77	39	17	0	13	0.3

turity period (90 days for Warba and 140 for Sequoia) were selected. These were planted at Wooster (silt loam) and McGuffey (muck) in two separate blocks, each of which contained all 10 varieties, in plots of four replicates each, arranged in a random distribution pattern. One block at each location was sprayed and the other was left unsprayed. This arrangement provided an opportunity to test all varieties in an area where insects would be subjected as little as possible to the influence of DDT (5) The spray mixture consisted of 4 pounds of COC-S (copper oxychloride sulfate) and 1 pound of a 50 per cent formulation of DDT in each 100 gallons of water. Applications were made every 10 days at the rate of 180 gallons per acre.

Early blight, leafhoppers, and flea beetles were present and comparatively severe at Wooster, but late blight was absent. Early and late blights occurred at McGuffey, flea beetles were scarce, and leafhoppers virtually absent Data on the relative degrees of defoliation due to early blight, numbers of leafhopper nymphs, and flea beetle punctures on the different varieties were obtained at Wooster. These data are given in table 1. No data on insect populations (no leafhoppers present) or defoliation due to early and late blights were obtained at McGuffey but the data relative to yield are given in table 2.

TABLE 2—*The influence of spraying with COC-S + DDT on the yield of 10 varieties of potatoes grown at McGuffey in 1946. Leafhoppers absent from all plots.*

Varieties	Yield in Bushels per Acre		Increase Due to Spraying	
	Unsprayed	Sprayed	Bushels	Per cent
Warba	387	599	212	55
Bliss Triumph	436	643	207	47
Cobbler	490	610	120	25
Katahdin	436	588	152	35
Chippewa	512	664	152	30
Pontiac	517	740	223	43
Sebago	354	495	141	40
Erie	479	664	185	39
Russet Rural	310	539	229	95
Sequoia	425	545	120	28
Averages	430	610	180	42

Of the varieties used in these comparisons (see table 1) the most resistant to leafhopper injury are Sequoia, Sebago, Russet Rural, and Katahdin Irish Cobbler, Warba, Chippewa, Pontiac, and Bliss Triumph are more susceptible Sequoia is somewhat resistant to damage by flea beetles, whereas Pontiac is especially susceptible to injury by this

insect. Sequoia and Sebago possess some resistance to late blight but all of the others are comparatively susceptible to attack by this disease.

In the Wooster experiment (table 1) the three varieties with the highest leafhopper populations (Warba, Bliss Triumph, and Pontiac) showed the greatest percentage of increase in yield from spraying with COC-S plus DDT The average leafhopper index was 44 nymphs per 10 leaves which was accompanied by a yield increase of 134 per cent, whereas the three varieties (Sequoia, Russet Rural, and Erie) with the lowest average nymph population (less than one on 10 leaves) showed a yield increase of only 97 per cent Since other yield inhibiting factors did not vary so widely as the population of leafhopper nymphs, it seems likely that the control of this particular insect by DDT was responsible for the large yield increases on Warba, Bliss Triumph, and Pontiac. In other words, varieties most susceptible to leafhopper injury showed the greatest yield increases when this insect was controlled by the use of DDT. This substantiates the conclusions of Sleesman and Bushnell (3) who found that Bordeaux mixture brought about the greatest increase in yield on Bliss Triumph, which is highly susceptible to leafhopper injury, and the least increase on the comparatively resistant Sequoia The greatest actual increase in yield (in terms of bushels per acre) occurred with Pontiac. This is a strong-growing variety which is comparatively susceptible to damage by leafhoppers, flea beetles and early blight Erie, which showed one of the lowest percentage increases in yield, probably because of the comparatively high yield of the untreated check plots, also responded well to spraying with an increase of 272 bushels per acre. An examination of the averages for all 10 varieties shows that yields were doubled, defoliation halved, flea beetle damage reduced by nearly 80 per cent, and that leafhoppers were eliminated by spraying at 10-day intervals with this COC-S plus DDT combination.

As mentioned previously leafhoppers were very scarce at McGuffey and flea beetles caused only slight damage, even in the untreated variety block Early blight was severe late in the season and late blight caused some defoliation of untreated plots for a period of a few days during the latter part of the growing period. The data relative to yield are given in table 2 Check (untreated plots) yields were comparatively high and as a result the actual and percentage increases due to spraying were somewhat smaller than at Wooster With the exception of Russet Rural, which for unexplainable reasons had an extremely low check yield, the same three varieties that showed the best response to spraying at Wooster (Warba, Bliss Triumph, and Pontiac) repeated at McGuffey. The Cobbler variety again showed one of the smallest increases caused by spray-

ing, and Pontiac for the second time gave the largest increase in yield of the 10 varieties under comparison. Sequoia assumed a position more in agreement with its high resistance to insect and disease attack than it did at Wooster, since it was comparatively unresponsive to the disease and insect control afforded by the combination of COC-S and DDT. The average yield increase caused by spraying for all 10 varieties was only 42 per cent at McGuffey, compared with 105 per cent at Wooster where insects were more plentiful. This indicates that the control of insects, particularly leafhoppers, may be more effective in increasing yields than the control of diseases, since diseases were more severe at McGuffey, whereas insect injury was greater at Wooster.

As a result of the experimental data obtained in the spraying of potatoes in 1945 (4) three control formulas were selected as being satisfactory for use on that crop in Ohio in 1946 The fungicides were Bordeaux mixture, COC-S, and Zerlate, each to be used with DDT as the insecticide To check the validity of this choice all three combinations were used on each of three varieties at Wooster and McGuffey. The data obtained are given in table 3.

The disease and insect complexes were similar to those described for the larger variety experiment. Data on defoliation were obtained only for Wooster, where Zerlate gave the best average control of early blight, followed in turn by Bordeaux and COC-S. Zerlate-treated plots gave the highest average yield at Wooster where early blight was chiefly responsible for defoliation, followed in turn by COC-S and Bordeaux. At McGuffey, where late blight was comparatively severe for a short time late in the growth period of the potato plants, Zerlate ranked third and COC-S took over top ranking. In the general average, however, Zerlate still gave slightly better results in yield as well as in the control of early blight Katahdin again showed a greater response to spraying than did Irish Cobbler, or Erie, as it did in the variety trials, especially those at Wooster.

Summary

Potato varieties vary considerably in their susceptibility to injury from the attack of insects and diseases Since this is true, one may assume that the different varieties will respond in varying degrees to the application of spray materials that will control these pests Ten varieties of potatoes, all of which are grown to some extent in Ohio, and which vary widely in the time necessary for them to mature, were sprayed with COC-S plus DDT (4-1-100) in a study of varietal response to this control formula.

TABLE 3.—*Relative performance of three control formulas recommended for use in spraying potatoes in 1946 DDT used with each fungicide at 1-100.*

Variety		Irish Cobbler		Katahdin		Erie		Average	Average Per cent of Foliage Dead on Aug 17 at Wooster
		*W	M	W	M	W	M		
Bordeaux	8-8-100	365	604	395	566	528	659	520	26
COC-S	4-100	356	610	582	588	457	664	543	29
Zerlate	2-100	414	588	561	583	539	626	554	21
No treatment		220	441	215	436	318	479	352	82
Variety averages when sprayed		378	601	513	579	508	650		
Average both locations			490		546		579		

*W=Wooster M=McGuffey

The three varieties which responded most to spraying were Warba, Bliss Triumph, and Pontiac. Bliss Triumph and Pontiac are possibly more susceptible to leafhopper damage than any other of the 10 varieties used Warba was the earliest of the group and this may have accounted for its large yield increase when sprayed. Irish Cobbler, Chippewa, and Erie, as a group, responded no more than Sequoia, Sebago, Russet Rural, and Katahdin, although they are usually ranked as being more susceptible to hopper damage.

The data as a whole suggest that the response to spraying in these experiments was more closely correlated with varietal susceptibility to disease than to insects, since damage from the former was the greater.

Averages of the data from all 10 varieties at Wooster show that yields were doubled, defoliation was halved, and leafhopper and flea beetle damage were reduced to almost nothing by spraying with COC-S and DDT

In a third experiment conducted at both Wooster and McGuffey in which three standard spray recommendations were compared one with another on Irish Cobbler, Katahdin, and Erie, Katahdin showed the greatest increase as a result of spraying Zerlate gave the best control of early blight, but was less effective than COC-S or Bordeaux against late blight COC-S and Bordeaux were approximately equal in disease control efficiency at both locations.

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SECTIONAL NOTES

INDIANA

The weather this season is reducing the yield of our potato crop considerably I would not be surprised if we experienced a loss of 20 per cent of the estimate, which would bring us down below four million bushels Judging from what I have seen of the crop so far the quality is also below normal The Cobblers are not only slightly rough with some wireworm damage, but also show a trace of late blight on the

tubers All of these factors, coupled with the hot weather, have not been conducive to good storage conditions and the usual local supply for the various towns is almost nothing.

Late blight has disapeared almost entirely. Our growers also have good control of the insects on their potatoes, so that favorable growing conditions from now on will determine the yield of our late crop (Aug 2).—W. B WARD

MISSOURI

The harvesting of Missouri's mid-season commercial potato crop is just about completed An estimated 1600 acres have been harvested, and you will recall that more than 1200 acres were destroyed by the June floods

The yields from different fields were quite variable owing to unfavorable weather during the season, ranging from extremely low up to 500 bushels per acre. The average was around 200 bushels per acre.

In most fields, the quality was only fair. The potatoes fell below the U S No 1 grade because of small size, growth cracks, and some sand rust.

The prices received by growers were not too good Few of them sold for $3 50 per hundred and others barely paid for their freight The majority were not sold on Government grade, and brought from $1 75 to $2 25 per hundred Red Warba potatoes averaged 40 to 60 cents a sack higher than did the Cobblers

More than 500 cars rolled by rail, most of which went to Chicago Trucks moved the equivalent of a few more carloads. The Government price support program purchased 25 cars of potatoes in this area during July

Local labor was plentiful during the harvest season. Many growers have potato harvesters which worked quite satisfactorily in the sandy soils, but in the heavier dry soils the clods were quite troublesome It was practically impossible to keep some clods from getting into the sacks Some growers modified their potato harvesters to give a longer platform so that more workers could help sort the potatoes Other growers used the older type diggers and picked the potatoes from the ground

A number of fertilizer demonstrations were conducted this season The results of these tests will be summarized and presented to the growers at their annual meeting. (Aug 13) —ALLAN PURDY.

NEBRASKA

Nebraska potato growers in the western main crop areas faced one of their most difficult planting seasons on record. Following quite an

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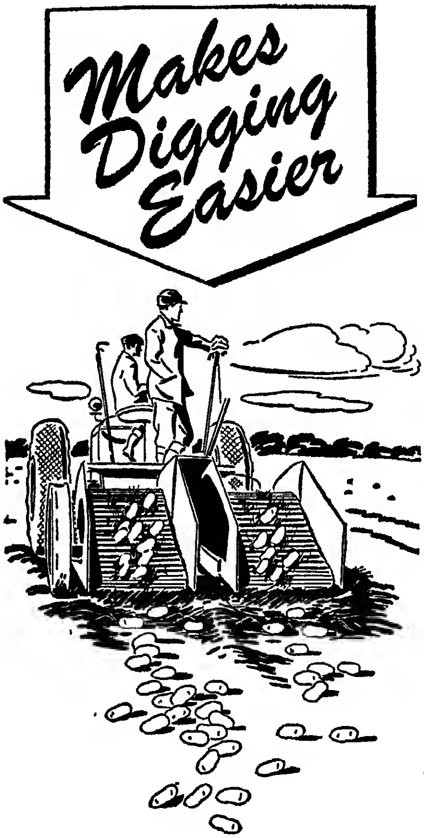

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open and dry winter, the months of February and March were also dry and windy. Growers were talking about a re-occurrence of the drought years of the '30's until the fore part of May Suddenly the situation changed, and the other extreme became prevalent Now just what happened throughout the corn belt areas, and in Nebraska during the floods in May and June is an old story This situation extended to the western part of the state as well

Western Nebraska had a snow storm on the 28th of May that amounted to 14 inches in the vicinity of Alliance, Nebraska On the 11th of June another snow storm covered most of the western area, and was accompanied by severe freezing that damaged crops throughout the area. Intermittent storms occurred throughout this period, and on the 21st and 22nd of June a severe storm began in the Rocky Mountain areas and extended across Wyoming and Nebraska, bringing rains ranging from 3 to 6 inches This not only disrupted farming, but also the railroad service and practically everything imaginable Some small line railroads have not, as yet, restored service and it required from two to three weeks to repair the damage on the main lines The weather bureau reported that the month of June showed the highest precipitation on record of any month since records have been taken,—approximately 65 years.

Planting extended from early June until the middle of July,—far past the common accepted dead line. Many fields were replanted either because of being drowned out or being hailed out. There was an unprecedented demand for seed potatoes until the 10th of July, to replace other crops lost by the extremely serious hail storms

The inspection of certified potatoes has been under way for nearly two weeks, with the plants ranging in size from 4 to 6 inches in height to 2 feet. Confusion reigns everywhere It is very difficult to ascertain the total amount of damage, or the probable crop prospects, because of the great variety of planting dates and field conditions At this time we are experiencing a heat wave, which has extended for ten days, with temperatures of 100° and above every day There has been no rain for nearly three weeks and there is a critical need for it

Although the growers voted favorably for a marketing agreement, there seems little need for it at this time.

The central and early crop marketing have been in operation for ten days, with good yields and good quality reported The price, at present, to the grower is $2.25. (Aug 6) —MARX KOEHNKE.

NEW YORK

Growers in up-state New York are much concerned about crop prospects. The acreage is down, stand is poor, and blight made its appearance at an earlier date than has ever been recorded

There was no trouble in getting most growers to comply with the government allotment but the allotment is far from being filled A P & M. A. official reported that in one of our potato counties the checked acreage was a little above 70 per cent of the alloted acreage on the average Generally speaking growers are satisfied with the support price announced by the government but they are not satisfied with the method of support Not much concern is expressed however, because local opinion would indicate that the shortage in the crop would keep prices above support levels

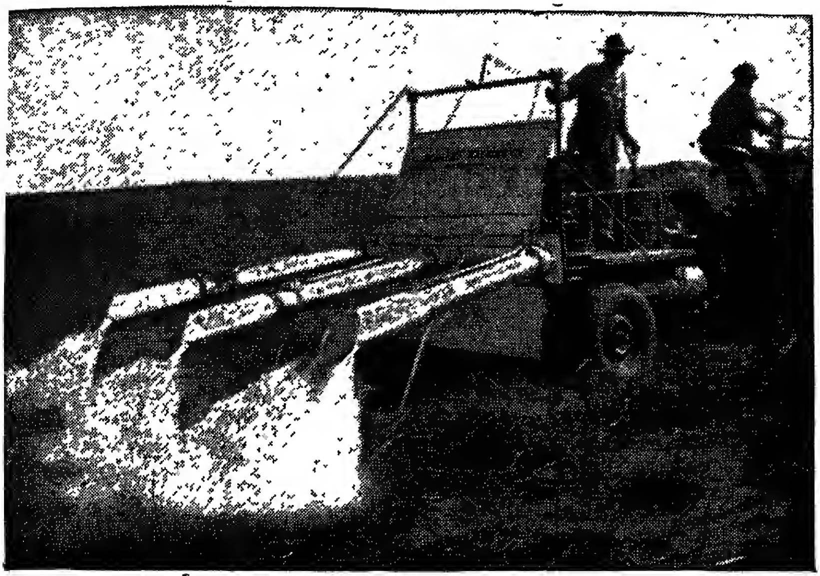
The stands vary from total failure to nearly perfect stands depending on circumstances in the particular area In several of our muck sections entire fields were drowned out and in many upland areas the low parts of the field were also drowned out causing a very spotted appearance. Apparently the season was conducive to seed piece rot and in many cases the stand was very poor Even after the potatoes had emerged and were growing late spring rains accumulated in low pockets and caused considerable damage

Seldom does blight occur in up-state New York before August but this year a general infestation was noted early in July The fields, in many cases, were so wet that growers were unable to spray and there has been more airplane and helicopter dusting this year than any one anticipated One grower indicates that parts of his field are so bad that the vines are dying and he expects a big reduction in his crop even if he can control blight in the better drained parts of his field. Much attention is being given to the blight immune varieties introduced in recent years by Dr Reddick This year certainly will give them a test

There is also much interest in the Teton variety which started off with a vigorous growth and so far has met all expectations except that it shows a little spindle tuber This Spindle Tuber is hard to detect because of the varietal characteristics of the plant The demand for seed of this variety far exceeds the possible available supply (Aug 4) —H J Evans

NORTH DAKOTA

North Dakota potatoes continue to make good growth with soil moisture above normal and the weather seasonally warm Despite a number of heavy rains which have flooded the low spots in one or two



districts the weather has not been favorable for late blight and there have been no reports of this disease

The North Dakota potato growers also grow grain, some to the extent of several thousand acres, and they are now busy directing the harvesting of another bumper crop At present prices the 1947 wheat crop is valued well above the return from the crop of the entire 10-year period 1930-1939. Although the grain harvesting season is an extremely busy one, it would nevertheless be difficult to find a potato field that lacks attention All fields have been uniformly well cultivated and dusted. As the vines meet between the rows a number of producers are shifting from tractor dusting to dusting by plane

Growers and officials from seed buying areas are frequent visitors throughout the growing season Thirty-five farmers and businessmen from the vicinity of Steuben County, New York, inspected fields and compared notes with growers in the Grand Forks-Park River-Hatton area on the 6th of August Wm Stempfle, Farm Bureau Agent of Steuben County, and Wm C Case, Executive Secretary of the Red River Valley Potato Growers' Association guided the group which ranged from 75 to 125,—at the various stops. Among the items of special interest were different varieties, field and storage practices, warehouses and processing plants, and the feeding of potatoes to livestock (Aug 9) —HAROLD MATTSON.

OHIO

Growers along the Ohio River started to dig Cobblers during the week of the 4th of July Most of the acreage in this section of the state is small, but digging is now getting under way in the larger sections in Coshocton and New Carlisle. There will be a fair movement of potatoes to the market this week. Packing in pecks also began this week with the price to growers being 55 cents delivered

Cobblers are yielding a fair crop, but the total crop will be approximately one-third of last year

In most sections of the state it has been cold and wet, therefore the late crop was not planted until the latter part of June, some as late as the first week of July A late season will be necessary if these potatoes are to produce a fair yield (Aug 4) —E B. TUSSING

VIRGINIA

Harvesting on the Eastern Shore was completed early in August Excellent yields were obtained in the northern part of Accomac County where the precipitation had been better than on the rest of the Shore Some late blight occurred in that area during the latter part of July, but

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it did not affect the yield, or cause much tuber infection (Aug 12) — HAROLD T COOK

WASHINGTON

In the Yakima Valley and in the area around Moses Lake the red potatoes are practically harvested Harvesting of White Rose potatoes is under way and will continue for another week or 10 days The early crop of Netted Gems is starting to come in and harvesting of this variety will be rather heavy about the middle of August

In some fields of White Rose, early blight infections have appeared but losses due to this disease are negligible Most of the fields have been relatively free from mosaic and leaf roll but an occasional lot of seed has been poor and as much as 60 per cent of the plants have shown virous diseases A sprinkling of ring rot has appeared in many of the commercial fields and its presence is difficult to explain As nearly as can be determined at present it is not in the certified seed but has gotten into the fields through careless handling of the seed after it was cut and while being planted Contaminated sacks, bins and planters appear to be largely responsible for the presence of the disease in a number of fields Growers are becoming aware of the danger and their interests indicate that measures will be taken to clean up ring rot before another season approaches. (July 29) —M R HARRIS.

CANADA

Growing conditions for potatoes have been excellent during the past two weeks, resulting in unusual growth Despite the wet, backward weather conditions during normal planting season, the crop now looks good, except for several late planted fields Our present average yield estimate is 80.4 cwt per acre Late blight has already been observed With excessive top growth, coupled with warm, moist conditions, this may be a blight year.

Marketing of the early crop is progressing satisfactorily, with most of the shipments made on a growers' cooperative basis Enforcement of regulations under the Plant Disease Act in connection with Bacterial Ring Rot, recently resulted in 12 court cases with total fines of $296.00 Efforts are now being made to keep this disease at the minimum and protect our seed supply More than $25,000.00 worth of seed from Ontario was shipped to New York State from one locality during April of this year The demands for disease-free seed are on the increase and are capable of producing vigorous stock, true to variety, and of good type (Aug 6) —R E GOODWIN.

Export sales of certified seed potatoes in 1946 showed an increase of 838,837 bushels compared with 1945, which was only 100,000 bushels less than the record sales of 1944 Domestic sales from the 1946 crop show a decrease of 590,020 compared with 1945.

In addition to the above, 70,000 long tons of table stock potatoes were sold to the United Kingdom A large portion of this order was composed of potatoes eligible for certification, and inspections for bacterial ring rot, as well as for grade, were carried out

The number of applicants for field inspection in 1947 shows a slight increase above that of 1946, whereas a decrease of 8,163 acres is recorded

Growth has been very backward in Eastern Canada, where late frosts and cold rains delayed the planting for several weeks In Nova Scotia, planting was not completed until the 3d of July In British Columbia, the first field inspections, the earliest on record, were made on the 5th of June. On the same date, late blight was found in a field of table stock in the lower Fraser Valley In the Prairie Provinces, planting was normal —W N KEENAN, *Chief, Plant Protection Division*

ANNUAL MEETING, POTATO ASSOCIATION OF AMERICA

DECEMBER 28-29-30, CHICAGO, ILLINOIS

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President Marx Koehnke has appointed the following to take care of committees and special assignments:

Secretary—Reiner Bonde.
Registration—Harry Reiley
Chairman Joint Meeting Phytopathology—O D Burke
Honorary Members—Frank Garrett
Certification Committee—Henry Darling
Potato Research—E V Hardenburg, Ora Smith.
Potato Breeding—Harold Matson
Culture and Storage—H O Werner
Virus and Bacterial Diseases—R L. Larsen
Insect Problems—George M List
The tentative program follows.

SUNDAY, DECEMBER 28

9 00 a m, Potato Association—Private Dining Room 9
1 30 p m, Potato Association—Private Dining Room 9

MONDAY, DECEMBER 29

9.00 a m, Potato Association—Private Dining Room 9
1 30 p m, Potato Association—Private Dining Room 9
7 30 p m, Potato Association—Private Dining Room 18
9 00 a m, Joint session with American Phytopathological Society —So Ballroom
1 30 p m, Joint session with American Society for Horticultural Science—Private Dining Room 17

The joint session with the American Phytopathological Society will be held at the Stevens Hotel All others at the Palmer House

American Potato Journal

PUBLISHED BY

THE POTATO ASSOCIATION OF AMERICA

NEW BRUNSWICK, N. J

STUDIES ON POTATO NUTRITION III. CHEMICAL COMPOSITION AND UPTAKE OF NUTRIENTS BY KERN COUNTY POTATOES[1]

O. A. LORENZ

Division of Truck Crops, University of California, College of Agriculture, Davis, Cal.

INTRODUCTION

Previous publications, (1), (2), presented certain information regarding the effect of fertilizer treatment and time of sampling on chemical composition and nutrient uptake by potatoes grown in Kern County, California. This paper presents similar but more complete results gathered from plantings made during 1945 and 1946.

METHODS

The potatoes were grown at the U. S Cotton Experiment Station at Shafter on a Hesperia fine, sandy loam soil Comparisons were made of potatoes grown with four different fertilizer treatments namely. none, 50 pounds, and 100 pounds of nitrogen per acre from ammonium sulfate and a fourth treatment containing the highest rate of nitrogen in addition to 125 pounds each of phosphoric acid and potash These treatments should fairly well represent the extremes in composition and nutrient uptake by potatoes grown in this area. The fertilizer was placed by an

[1]The author acknowledges his indebtedness to Mr. George J Harrison, Agronomist, U S Cotton Field Station, Shafter, California, for providing the land and for aid in the growing and harvesting of the potatoes and to Mr James Perdue and Mas Yamaguchi of the Division of Truck Crops, University of California, for aid in the chemical analysis

experimental machine two inches to one side and two inches below the seed piece at planting The rows were spaced 30 inches apart. The seed pieces were planted by hand approximately seven inches deep and were spaced exactly one foot apart in the row. Samples for growth and chemical analysis consisted of ten hills from each of duplicate plots of each fertilizer treatment except for the final sampling at time of harvest where the weights recorded were obtained from a larger fertilizer experiment and represent the average of two rows per plot each 125 feet long. Eact plot was replicated four times. The last tuber yields reported would thus be more accurate than those obtained from the smaller plots harvested earlier. Tubers were separated from the remainder of the plant and analyzed separately Since the soil was of very light texture, many of the small fibrous roots and small stolons were recovered. Methods of analysis were those of A O A. C., except for potassium which was determined volumetrically by the Cobaltinitrite method.

Certified seed of the White Rose variety was planted on the 19th of February, 1945, and on the 14th of February, 1946 In both years 95 per cent emergence was noted approximately 30 days after planting. Sampling was begun when the plants were about six inches high and was continued at approximately two-week intervals until harvest which was on the 18th of June during both years. Daily irrigations in alternate furrows were begun about two weeks after plant emergence and continued until one week before harvest. There was practically no tuber growth previous to one month after emergence although enlargements at the ends of the stolons were noted soon after plant emergence During the last two weeks of growth some of the leaves became mature, dried up, and dehisced. This accounts for the lower amount of plant growth at the last sampling than sometimes reported for slightly earlier samplings. Potatoes grown in this area are often harvested at about 100 days after planting as compared with growing periods of 119 and 124 days reported here. In both years the tubers were quite well matured at the time of harvest, however those grown on the plots lacking nitrogen were the most mature.

RESULTS

Tables 1, 2, and 3 present data on the effect of fertilizer treatment and time of sampling on nutrient and dry-matter content

Nitrogen

In plants of the 1945 crop the nitrogen content decreased approximately one-half from the first sampling to the last. The decrease was somewhat greater in the nitrogen-fertilized plants than in those unfer-

TABLE I —*Effect of fertilizer treatment and time of sampling on nutrient content of potatoes.* 1945 *crop.*

Date of Sampling	Portion Sampled	Fertilizer Treatments — Pound per Acre of N, P_2O_5, and K_2O Respectively											
		0 — 0 — 0			50 — 0 — 0			100 — 0 — 0			100 — 125 — 125		
		Per cent of Dry Weight											
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
4-20	Plant	5.48	0.98	6.1	6.06	1.11	6.9	6.37	1.12	6.6	6.23	1.65	6.8
	Tuber	—	—	—	—	—	—	—	—	—	—	—	—
5-3	Plant	3.69	0.73	7.1	5.80	0.34	6.6	5.90	0.34	6.6	5.64	0.53	6.6
	Tuber	1.78	0.76	3.6	2.50	0.73	3.8	2.67	0.67	3.6	2.43	1.10	3.6
5-18	Plant	3.01	0.77	6.0	3.92	0.66	5.1	4.04	0.45	5.6	4.03	0.66	5.0
	Tuber	1.25	0.41	2.8	1.50	0.32	2.8	1.61	0.34	2.6	1.45	0.53	2.6
6-1	Plant	3.01	0.44	5.4	2.67	0.30	4.0	2.94	0.26	3.8	2.62	0.33	3.6
	Tuber	1.06	0.47	2.7	1.10	0.32	2.3	1.22	0.42	2.4	1.21	0.39	2.4
6-18	Plant	2.41	0.34	4.3	2.39	0.29	3.8	2.64	0.36	3.5	2.38	0.37	3.5
	Tuber	1.14	0.47	2.7	1.13	0.32	1.7	1.37	0.31	2.2	1.27	0.34	1.8

TABLE 2.—*Effect of fertilizer treatment and time of sampling on nutrient content of potatoes. 1946 crop.*

Date of Sampling	Portion Sampled	Fertilizer Treatments — Pound per Acre of N, P_2O_5, and K_2O Respectively											
		0 — 0 — 0			50 — 0 — 0			100 — 0 — 0			100 — 125 — 125		
		Per cent of Dry Weight											
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
4-20	Plant	3 76	68	5 8	4 72	87	6 0	5 91	98	6 0	6 33	1 57	5 6
	Tuber	2.11	.70	3 2	2 24	72	3 0	2 57	83	2 9	2 91	97	3 2
5-1	Plant	3 43	.48	5 8	4 33	68	5 1	4.84	67	6 4	4 89	1 02	6 5
	Tuber	1 19	40	3 1	1 50	51	3 1	1 74	.52	2 9	1 78	77	2 9
5-16	Plant	2 87	31	5 5	2 90	31	5 2	3 25	.27	4 9	3 00	37	4 7
	Tuber	1 16	25	2 4	1.12	28	2 4	1 22	.27	2 4	1.30	40	2 3
6-1	Plant	2 90	41	4.6	2 52	25	4.6	2 78	26	4 6	2 64	29	4 8
	Tuber	1 26	29	2 5	1 07	22	2 2	1.15	23	2 2	1 17	33	2 5
6-11	Plant	2 90	46	5 3	2 49	31	4 1	2 34	24	3 9	2 22	25	3 3
	Tuber	1 31	33	2 5	1 06	26	2 2	1.08	22	1 9	1 05	29	1 8
6-18	Plant	2 73	45	5 0	2 10	.34	4 0	1 81	20	3 2	1 73	25	3 0
	Tuber	1 27	32	3 0	0 95	31	2 2	1 10	25	2 1	1 10	33	2 0

TABLE 3.—*Effect of fertilizer treatment and time of sampling on dry matter content of potatoes*

Portion Sampled	1945 Crop: Date of Sampling	1945 Crop: Fertilizer Treatment — Pounds per Acre of N, P2O5, K2O: 0-0-0	50-0-0	100-0-0	100-125-125	1946 Crop: Date of Sampling	1946 Crop: Fertilizer Treatment — Pounds per Acre of N, P2O5, K2O: 0-0-0	50-0-0	100-0-0	100-125-125
		Dry Weight as per cent of Fresh					Dry Weight as per cent of Fresh			
Plant	4-20	9.6	9.1	8.8	8.8	4-20	14.5	11.9	11.6	11.9
Tuber		—	—	—	—		14.6	13.4	12.8	12.4
Plant	5-3	12.5	11.2	11.1	10.8	5-1	13.7	11.2	11.4	10.6
Tuber		11.6	10.8	11.0	10.5		13.5	12.5	12.9	12.6
Plant	5-18	14.3	14.2	12.8	12.3	5-16	17.7	15.0	15.3	14.9
Tuber		15.7	16.3	15.3	16.5		18.3	18.2	18.3	18.2
Plant	6-1	16.9	17.6	15.6	16.2	6-1	20.0	17.5	15.1	14.5
Tuber		18.3	19.0	18.8	18.7		18.9	21.3	21.3	20.8
Plant	6-18	16.0	15.6	15.8	15.2	6-11	20.3	18.2	16.6	15.5
Tuber		22.2	23.5	22.6	23.1		19.3	21.8	22.4	23.2
Plant						6-18	30.6	30.3	31.6	26.5
Tuber							20.4	22.5	23.8	24.3

tilized. Plants that received nitrogen fertilizer were appreciably higher in nitrogen content than those unfertilized but in mature plants there was little or no difference. The nitrogen content of the tubers also decreased with maturity. Tubers grown on plots receiving nitrogen fertilizer were considerably higher in nitrogen content during early growth but in mature tubers there was very little difference At the time of field harvest (119 days after planting) tubers grown on unfertilized plots contained 1 14 per cent N as compared with 1 13 and 1 37 per cent for those grown on plots given 50 and 100 pounds of nitrogen per acre, respectively

The 1946 crop showed similar decreases in nitrogen content with maturity Plants and tubers grown without nitrogen were lower in nitrogen content during the early stages of growth than those receiving nitrogen fertilizer but at maturity were even higher

Phosphorus

The phosphorus content of both plants and tubers showed a marked decrease from early growth until maturity In the young plants and tubers there was a marked increase in phosphorus content due to phosphate fertilization but in mature plants and tubers there was either no difference or only a slight increase In 1945 tubers at final harvest contained 0 34 per cent P_2O_5 when grown on phosphorus-fertilized plots as compared with 0 31 per cent if grown with equal amounts of nitrogen and potassium but lacking phosphorus. In 1946 comparable figures were 0 33 and 0 25 per cent P_2O_5.

Potassium

The potassium content of both plants and tubers decreased with age. Potash applications had no effect on the potassium content of either plants or tubers at any stage of growth. Mature tubers grown on the potash-treated plots contained 1 8 per cent K_2O in 1945 and 2 0 per cent in 1946

Dry Matter

The dry-matter content of both plants and tubers was much less in the early stages of growth than later. The tubers showed a gradual increase in dry matter from the first sampling until the time of harvest In mature tubers of the 1945 crop there was no effect of fertilizer treatment on total dry matter but in 1946 tubers produced on plots receiving nitrogen fertilizer were several per cent higher than those grown without nitrogen Conversely in the 1946 crop during the early stages of growth tubers grown on the unfertilized plots were the highest in dry matter. The large increase in dry matter as the plants and tubers matured ac-

TABLE 4.—*Effect of fertilizer treatment and time of sampling on growth and nutrient absorption by an acre of potatoes. Unfertilized plots*

Portion Sampled	1945 Crop						1946 Crop					
	Date of Sampling	Growth—Pounds per Acre		Nutrients Absorbed Pounds per Acre			Date of Sampling	Growth—Pounds per Acre		Nutrients Absorbed Pounds per Acre		
		Fresh Weight	Dry Weight	N	P_2O_5	K_2O		Fresh Weight	Dry Weight	N	P_2O_5	K_2O
Plant	4-20	826	79	4.3	0.8	4.8	4-20	1467	213	8.0	1.5	12.4
Tubers	(60)*	—	—	—	—	—	(65)*	826	121	2.6	0.9	4.0
Total		826	79	4.3	0.8	4.8		2293	334	10.6	2.4	16.4
Plant	5-3	2546	317	11.7	2.3	22.7	5-1	3203	438	15.0	2.1	25.5
Tubers	(73)	843	98	1.7	0.7	3.6	(76)	4721	638	7.6	2.6	19.4
Total		3389	415	13.4	3.0	26.3		7924	1076	22.6	4.7	44.9
Plant	5-18	4552	649	19.5	5.0	38.9	5-16	2951	521	15.0	1.6	28.8
Tubers	(88)	6913	1081	13.5	4.5	30.9	(91)	9610	1754	20.4	4.4	42.9
Total		11465	1730	33.0	9.5	69.8		12561	2275	35.4	6.0	71.7
Plant	6-1	5142	867	26.1	3.8	47.3	6-1	3777	756	21.9	3.1	35.2
Tubers	(102)	10200	1871	19.8	8.8	51.4	(107)	13235	2507	31.6	7.2	61.9
Total		15342	2738	45.9	12.6	98.7		17012	3263	53.5	10.3	97.1
Plant	6-18	6828	1091	26.3	3.7	47.3	6-11	4906	997	28.9	4.6	53.5
Tubers	(119)	13100	2903	33.1	13.6	79.0	(117)	16573	3205	42.0	10.7	79.9
Total		19928	3994	59.4	17.3	126.3		21479	4202	70.9	15.3	133.4
Plant							6-18	2495	763	20.8	3.4	37.9
Tubers							(124)	16500	3364	42.7	10.9	100.5
Total								18995	4127	63.5	14.3	138.4

*Figures in parenthesis refer to number of days after planting

TABLE 5.—*Effect of fertilizer treatment and time of sampling on growth and nutrient absorption by an acre of potatoes. Fertilized with 50-0-0 pounds per acre of N, P_2O_5, and K_2O, respectively.*

Portion Sampled	1945 Crop						1946 Crop					
	Date of Sampling	Growth—Pounds per Acre		Nutrients Absorbed Pounds per Acre			Date of Sampling	Growth—Pounds per Acre		Nutrients Absorbed Pounds per Acre		
		Fresh Weight	Dry Weight	N	P_2O_5	K_2O		Fresh Weight	Dry Weight	N	P_2O_5	K_2O
Plant	4-20	1062	97	5.9	1.1	6.6	4-20	3726	443	20.9	3.9	26.7
Tubers	(60)*	—	—	—	—	—	(65)*	1602	215	4.8	1.6	6.4
Total		1062	97	5.9	1.1	6.6		5328	658	25.7	5.5	33.1
Plant	5-3	4569	514	29.8	1.8	33.8	5-1	7250	811	35.1	5.5	41.3
Tubers	(73)	894	97	2.4	0.7	3.7	(76)	6407	800	12.0	4.1	24.7
Total		5463	611	32.2	2.5	37.5		13657	1611	47.1	9.6	66.0
Plant	5-18	8599	1224	48.0	8.1	62.6	5-16	10369	1554	45.1	4.8	81.2
Tubers	(88)	10875	1769	26.5	5.6	49.9	(91)	21159	3851	43.1	10.8	90.2
Total		19474	2993	74.5	13.7	112.5		31528	5405	88.2	15.6	172.1
Plant	6-1	9695	1701	45.4	5.1	69.1	6-1	7014	1229	31.0	3.1	57.1
Tubers	(102)	18546	3522	38.7	11.3	82.7	(107)	25459	5410	57.9	11.9	118.7
Total		28241	5223	84.1	16.4	151.8		32473	6639	88.9	15.0	175.8
Plant	6-18	10116	1576	37.7	4.5	59.4	6-11	7182	1299	30.6	3.8	50.4
Tubers	(119)	23900	5609	63.4	18.0	130.4	(117)	31646	6889	73.0	18.1	149.4
Total		34016	7185	101.1	22.5	189.8		38828	8188	103.6	20.9	199.8
Plant							6-18	3355	1015	21.3	3.5	40.8
Tubers							(124)	31400	7049	67.0	21.8	153.7
Total								34755	8064	88.3	25.3	194.5

*Figures in parenthesis refer to number of days after planting.

TABLE 6—*Effect of fertilizer treatment and time of sampling on growth and nutrient absorption by an acre of potatoes. Fertilized with* 100-0-0 *pounds per acre of N, P_2O_5, and K_2O, respectively.*

Portion Sampled	1945 Crop: Date of Sampling	1945 Crop: Growth—Pounds per Acre: Fresh Weight	1945 Crop: Growth—Pounds per Acre: Dry Weight	1945 Crop: Nutrients Absorbed Pounds per Acre: N	1945 Crop: Nutrients Absorbed Pounds per Acre: P2O5	1945 Crop: Nutrients Absorbed Pounds per Acre: K2O	1946 Crop: Date of Sampling	1946 Crop: Growth—Pounds per Acre: Fresh Weight	1946 Crop: Growth—Pounds per Acre: Dry Weight	1946 Crop: Nutrients Absorbed Pounds per Acre: N	1946 Crop: Nutrients Absorbed Pounds per Acre: P2O5	1946 Crop: Nutrients Absorbed Pounds per Acre: K2O
Plant	4-20 (60)*	1113	98	6.2	1.1	6.5	4-20 (65)*	3305	382	22.6	3.8	23.1
Tubers		—	—	—	—	—		944	121	3.1	1.0	3.5
Total		1113	98	6.2	1.1	6.5		4249	503	25.7	4.8	26.6
Plant	5-3 (73)	6086	674	40.0	2.3	44.6	5-1 (76)	8936	1020	49.4	6.9	65.9
Tubers		1366	150	4.0	1.0	5.5		8599	1112	19.4	5.8	32.5
Total		7452	824	44.0	3.3	50.1		17535	2132	68.8	12.7	98.4
Plant	5-18 (88)	10622	1361	55.0	6.1	76.2	5-16 (91)	9442	1444	46.9	4.0	70.2
Tubers		9863	1512	24.3	5.1	40.1		18968	3475	42.4	9.2	82.0
Total		20485	2873	79.3	11.2	116.3		28410	4919	89.3	13.2	152.2
Plant	6-1 (102)	11296	1762	51.8	4.6	67.5	6-1 (107)	9138	1377	38.3	3.6	64.1
Tubers		22087	4145	51.0	17.4	98.4		31124	6617	76.1	15.2	145.0
Total		33383	5907	102.8	22.0	165.9		40262	7994	114.4	18.8	209.1
Plant	6-18 (119)	12645	1992	52.3	7.2	69.6	6-11 (117)	9695	1608	37.6	3.8	63.7
Tubers		26100	5901	80.5	18.2	128.0		32405	7262	78.4	16.1	140.0
Total		38745	7893	132.8	25.4	197.6		42100	8870	116.0	19.9	203.7
Plant							6-18 (124)	4013	1267	22.9	2.6	40.1
Tubers								37500	8940	98.3	22.1	192.7
Total								41513	10207	121.2	24.7	232.8

*Figures in parenthesis refer to number of days after planting

TABLE 7—*Effect of fertilizer treatment and time of sampling on growth and nutrient absorption by an acre of potatoes. Fertilized with 100-125-125 pounds per acre of N, P_2O_5, and K_2O, respectively.*

Portion Sampled	1945 Crop						1946 Crop					
	Date of Sampling	Growth—Pounds per Acre		Nutrients Absorbed Pounds per Acre			Date of Sampling	Growth—Pounds per Acre		Nutrients Absorbed Pounds per Acre		
		Fresh Weight	Weight Dry	N	P2O5	K2O		Fresh Weight	Dry Weight	N	P2O5	K2O
Plant	4-20 (60)*	1467	128	8.0	2.1	8.8	4-20 (65)*	2900	346	21.9	5.4	19.5
Tubers		—	—	—	—	—		776	96	2.8	0.9	3.0
Total		1467	128	8.0	2.1	8.8		3676	442	24.7	6.3	22.5
Plant	5-3 (73)	7435	800	45.1	4.2	52.7	5-1 (76)	10200	1076	52.6	11.0	70.1
Tubers		1669	176	4.3	1.9	6.4		7503	947	16.9	7.3	27.5
Total		9104	976	49.4	6.1	59.1		17703	2023	69.5	18.3	97.6
Plant	5-18 (88)	13151	1623	65.4	10.8	81.3	5-16 (91)	12982	1936	58.1	7.1	91.7
Tubers		11971	1969	28.6	10.5	51.2		23267	4223	54.9	16.8	98.2
Total		25122	3592	94.0	21.3	132.5		36249	6159	113.0	23.9	189.9
Plant	6-1 (102)	15511	2517	66.0	8.4	90.4	6-1 (107)	14651	2129	56.2	6.3	103.1
Tubers		22677	4245	51.4	16.5	100.7		40886	8521	99.7	27.7	210.4
Total		38188	6762	117.4	24.9	191.1		55537	10650	155.9	34.0	313.5
Plant	6-18 (119)	15596	2375	56.5	8.9	82.4	6-11 (117)	11144	1728	38.4	4.4	57.2
Tubers		31400	7238	91.9	24.9	162.2		42268	9806	103.0	28.7	177.2
Total		46996	9613	148.4	33.8	244.6		53412	11534	141.4	33.1	234.4
Plant							6-18 (124)	7216	1913	33.1	4.8	57.1
Tubers								39500	9614	105.8	31.3	195.7
Total								46716	11527	138.9	36.1	252.8

*Figures in parenthesis refer to number of days after planting

counts for most of the decrease in nitrogen, phosphoric acid, and potash per unit of the dry weight

Data on the effect of fertilizer treatment and time of sampling on growth and total nutrient absorption are presented in tables 4 to 7, inclusive In 1945 plants grown on plots without nitrogen made no tuber growth and very little plant growth until 60 days after planting. Plant growth was most rapid between 60 and 102 days whereas tuber growth was practically *nil* until 73 days after planting and then continued fairly uniformly until harvest in 119 days. In 1946 both plants and tubers had practically ceased growth 117 days after planting, however the grand periods of growth were similar to those of the previous year

The amounts of nutrients absorbed were closely related to growth. At harvest in 1945 an unfertilized crop yielding 131 sacks per acre had absorbed 59 pounds of nitrogen, 17 of phosphoric acid, and 126 of potash per acre. The tubers alone accounted for 33 pounds of nitrogen per acre, 14 of phosphoric acid, and 79 of potash Approximately one-half of the nutrients were absorbed during the last 30 days of growth In 1946 the crop which yielded 165 sacks contained 64 pounds of nitrogen, 14 of phosphoric acid and 138 of potash of which the tubers contained 43 of nitrogen, 11 of phosphoric acid, and 100 of potash About one-half of the nutrients was absorbed after 91 days of growth but in a three-week period immediately following.

Nitrogen applications very greatly increased growth and the amount of nutrients absorbed At harvest in 1945 potatoes fertilized with 100 pounds of nitrogen per acre and producing 261 sacks had absorbed 133 pounds of nitrogen, 25 of phosphoric acid, and 198 of potash. In 1946 comparable figures for a yield of 375 sacks were 121 pounds of nitrogen, 25 of phosphoric acid, and 233 of potash. The tubers alone in 1945 had removed 81 pounds of nitrogen per acre, 18 of phosphoric acid, and 128 of potash, whereas in 1946 the absorption was 98 pounds of nitrogen, 22 of phosphoric acid and 193 of potash The most rapid rate of nutrient absorption, particularly by the tubers, occurred between 70 and about 110 days after planting The nutrient absorption by plants fertilized with 50 pounds of nitrogen was approximately midway between those receiving none and 100 pounds of nitrogen per acre.

The nutrient absorption and growth were highest from the complete fertilizer treatment The absorption of phosphorus was materially increased by phosphorus fertilization. This was due not only to the slightly greater growth but also to a higher phosphorus content of the plants and tubers At harvest in 1945 a 314 sack crop contained 148

pounds of nitrogen per acre, 34 of phosphoric acid, and 245 of potash. Of this amount the tubers contained about two-thirds of the nitrogen and potash and about three-fourths of the phosphoric acid. In 1946 a crop which produced 395 sacks per acre contained 139 pounds per acre of nitrogen, 36 of phosphoric acid, and 253 of potash. The tubers alone accounted for 106 pounds of nitrogen, 31 of phosphoric acid, and 196 of potash

Discussion

The results presented in this paper agree fairly well with those reported earlier and show that the greatest amount of growth and the greatest intensity of nutrient absorption occur between about 75 and 110 days after planting or 45 to 80 days after plant emergence. This is shown graphically for one treatment in Figure 1 This treatment was used for illustration since it is the one receiving the fartilizer treatment

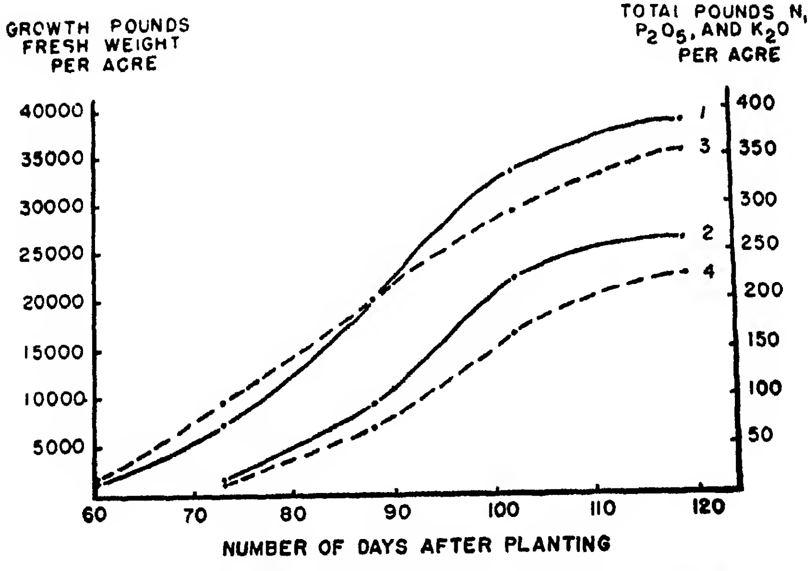

Fig. 1 Growth and nutrient absorption by an acre of potatoes, 1945 crop, fertilized with 100 pounds of nitrogen per acre. 1-Fresh weight of total plants. 2-Fresh weight of tubers. 3-Pounds of N, P_2O_5, and K_2O absorbed by total plants. 4-Pounds of N, P_2O_5, and K_2O absorbed by tubers

used most commonly for potatoes grown in this area and also produced what is considered as a good average yield for the area

The data gives certain information regarding the efficiency of the

nitrogen fertilizers applied. In 1945 plants which were unfertilized absorbed 59 pounds of nitrogen per acre as compared with 101 and 133 pounds for plants fertilized with 50 and 100 pounds of nitrogen per acre, respectively. Thus when 50 pounds of nitrogen were applied the recovery was 43 pounds and when 100 pounds were applied the recovery was 74 pounds Adding phosphorus and potassium to the 100 pounds of nitrogen treatment resulted in the absorption of a total of 148 pounds of nitrogen or 89 pounds of that applied. In 1946 unfertilized plants removed 64 pounds of nitrogen Those fertilized with 50 and 100 pounds of nitrogen removed 88 and 121 pounds per acre, respectively, or 24 and 57 pounds of the fertilizer originally applied. The complete fertilizer treatment removed 139 pounds of nitrogen or 75 pounds from the 100 pounds originally applied In all treatments where only nitrogen fertilizer was applied the tubers alone removed about one-half of the nitrogen supplied.

Summary

Comparisons were made on growth and on dry matter, nitrogen, phosphoric acid, and potash content of the potatoes grown at four different fertilizer levels during 1945 and 1946

Nitrogen content of plants and tubers was increased by nitrogen fertilization during the early stages of growth but this was not true at maturity.

Nitrogen, phosphoric acid, and potash greatly decreased per unit of dry weight in both plants and tubers as they approached maturity.

The greatest amount of growth and the greatest intensity of nutrient absorption occurred between about 75 and 110 days after planting or between 45 and 80 days after emergence

An unfertilized crop of potatoes grown in 1945 and producing 119 sacks contained 59 pounds of nitrogen per acre, 17 of phosphoric acid, and 126 of potash. The tubers alone removed 33 pounds of nitrogen, 14 of phosphoric acid and 79 of potash. The highest yielding treatment which in 1946 produced 395 sacks per acre, absorbed 139 pounds of nitrogen, 36 of phosphoric acid and 253 of potash. The tubers alone removed 106 pounds of nitrogen, 31 of phosphoric acid, and 196 of potash.

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INHERITANCE OF PREDISPOSITION OF POTATO VARIETIES TO INTERNAL MAHOGANY BROWNING OF THE TUBERS

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It has been shown that "internal mahogany browning" of the potato tubers of certain varieties is induced by continuous storage for several months at about 32° F, that leafroll increases the predisposition of a variety to the development of this injury, and that in addition to the culinary damage the injury in seed potatoes may reduce the stand and yield rate (4) Green Mountains were much less predisposed to this effect than were Chippewas and Katahdins. It has since been noticed that new seedling varieties may vary considerably in predisposition, within the same cross and as between seedlings in one cross and seedlings in another

The data presented here were obtained in the routine testing, for predisposition to mahogany browning, of seedling varieties found to be resistant to the natural spread of leafroll (3) One series of samples from the 1943 crop of certain seedling varieties was stored at 32° F. for several months in an experimental potato storage and another series from the 1946 crop of other seedling varieties was stored at about 31° F for six months in a commercial apple storage. The tubers were examined at the end of the period of storage Most of the injury in the 1943 series was typical (reddish brown) The injury in the 1946 series was more severe in certain varieties used in both tests, and was more diverse in character In some seedlings, yellowing and slate color developed, apparently as milder phases, instead of the typical browning, or along with it, whereas in others the brown tissues had become almost black and approached a "leaker" stage Cracks developed in the darker brown tissue and sometimes even in typical brown tissue. (See Fig 1). The results are given in tables 1 and 2 Other samples from the same seedlings of the 1946 series were kept in an experimental potato storage at 36° F and remained free from all injury.

The results in table 1 show that X750-10 and Chippewa are more predisposed to mahogany browning than X1276-48, X1276-185, X1247-48, or Green Mountain The results in table 2 show that under more severe conditions X1276-185 joins Chippewa, and Green Mountain more nearly approaches Chippewa, in predisposition, whereas Katahdin is more pre-

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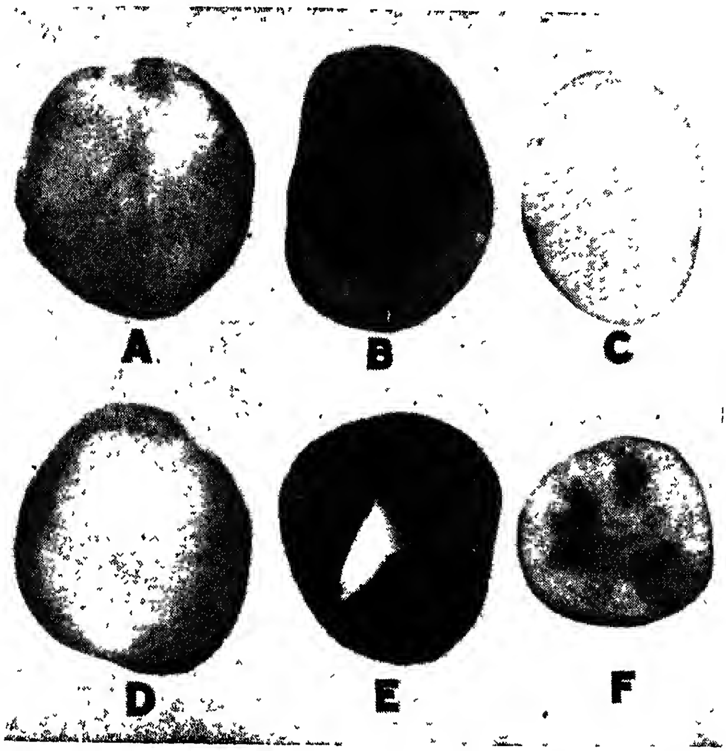

FIG 1 Tuber slices with internal mahogany browning from six months storage at about 31° F. A, Chippewa with the usual reddish brown injury; B, seedling variety B298-89 with small cracks in blackened tissue, C, seedling variety B298-16 with no injury; D, seedling variety B244-124 with cortical browning, E, seedling variety B410-59 with large central crack in blackened tissue, F, seedling variety B514-14 with radial cracks in brown islands of tissue Note that B and C are seedlings of the same cross.

disposed than Chippewa The much greater difference in predisposition between X750-10 and X1276-48 (Table I) is reflected in the crosses B410 and B420 (Table 2), in which these two seedling varieties were respectively crossed with X247-48 In Cross B410 the percentage of affected tuber flesh was much higher and the predominant or average type of injury was more severe, probably as the result of the use of the more predisposed X750-10 as a parent In the several crosses between X247-48 and commercial varieties, generally less predisposition was transmitted to the seedlings than in cross B410 In several crosses the extent of injury varied from none to 72-100 per cent as between seedlings

TABLE I.—*Comparison of various commercial and seedling varieties as to predisposition to internal mahogany browning,* 1943 *crop.*

Cross	Components of Cross	Variety	Injury	
			Kind	Prevalence (Per Cent of Tubers Affected)[1]
X750	Imperia x Katahdin	X750-10	Severe	100
X1276	Houma x Katahdin	X1276-48	Slight	40
X247	Kepplestone Kidney x Earlaine	X1276-185	Slight just below skin	100
		X247-24	Severe	100
		X247-30	Slight gray	20
		X247-42	Severe	60
		X247-48	Typical	60
B24	Imperia x Earlaine	B24-9	Severe	100
		B24-16	Severe	100
		B24-19	Typical	80
		B24-50	Slight	40
		B24-58	Slight gray	20
		B24-76	Severe	60
			Slight	40
		B24-78	Very slight	20
		B24-91	Slight	60
		B24-156	Typical	60
		B24-174	Typical	40
		B24-190	Typical	40
		B24-238	Typical	100
		B24-304	Typical	40
			Vascular	60
	40568 x 24642[2]	Chippewa	Severe	100
	Dunmore x Excelsior[2]	Green Mountain	Slight gray	10

[1]20 tubers of Chippewa and of Green Mountain, and 5 of each other variety, were kept at 32° F for several months

[2]See 1 and 2 of Literature Cited

DISCUSSION

Mahogany browning is still an important cause of loss in certain commercial varieties in a northern potato region such as Aroostook County, Maine The need to regulate storage temperature is an extra bother even if regulation is effective for control Predisposition to this form of injury should be tested in new seedling varieties considered for northern areas. Apparently the proper selection of the parents for crosses can be helpful in developing varieties resistant to this defect.

CONCLUSION

Predisposition to mahogany browning varies from one commercial

TABLE 2—*Comparison of various commercial and seedling varieties as to predisposition to internal mahogany browning, 1946 crop*

Cross	Components of Cross	Variety	Injury		
			Kinds[1]	Percentage of Tuber Flesh Affected[2]	Severity[3]
X1276	Houma x Katahdin	X1276-185	B	82	B
	40568 x 24642[4]	Chippewa	B	93	B
	Ditto[4]	Katahdin	BLC	97	BLC
	Dunmore x Excelsior[4]	Green Mountain	B	55	B
B410	X750-10 x X247-48	B410-3	BL	86	BL
		B410-10	SBC	72	B
		B410-44	SBC	82	B
		B410-56	BLC	100	BLC
		B410-59	BC	68	BC
		B410-76	SBLC	82	BLC
		B410-81	SBC	48	SB
		B410-101	BC	80	B
		B410-105	BLC	74	BC
		B410-111	BLC	96	BC
B420	X1276-48 x X247-48	B420-30	O	0	O
		B420-55	O	0	O
		B420-72	SBC	36	B
		B420-73	Y	2	Y
		B420-78	O	0	O
		B420-82	B	8	B
		B420-106	Y	3	Y
		B420-129	SBC	8	B
		B420-134	SBC	32	B
		B420-151	O	0	O
		B420-154	B	62	B
		B420-173	SB	34	B
		B420-174	SBC	28	B
		B420-175	BC	14	B
		B420-178	O	0	O
		B420-181	BLC	72	B
		B420-182	BL	37	B
		B420-185	B	30	B
		B420-186	B	4	B
		B420-206	S	12	S
		B420-208	BC	46	B
		B420-215	YSB	10	SB
B289	X247-48 x Katahdin	B289-30	BL	36	B
		B289-151	BC	13	B
B285	X247-48 x Green Mountain	B285-139	B	3	B
		B285-208	YB	24	B
		B285-216	B	17	B
		B285-219	B	36	B
B298	X247-48 x Houma	B298-16	O	0	O
		B298-17	O	0	O
		B298-21	O	0	O

Cross	Components of Cross	Variety	Injury		
			Kinds[1]	Percentage of Tuber Flesh Affected[2]	Severity[3]
		B298-60	B	30	B
		B298-78	B	47	B
		B298-79	O	0	O
		B298-80	BLCBl	100	BLC
		B298-82	B	43	B
		B298-83	O	0	O
		B298-88	O	0	O
		B298-89	BC	90	BC
		B298-94	YBC	30	YB
B308	X247-48 x Sebago	B308-68	B	17	B
B314	X247-48 x Sequoia	B314-3	SBC	76	BC
		B314-6	B	6	B
		B314-25	B	10	B
		B314-48	B	28	B
		B314-49	B	2	B
		B314-66	B	3	B

[1]Y=yellowing, S=slate-color in flesh; B=browning, L="leaker" effect somewhat like that of severe freezing, but with dark color developed before tuber is cut, C=cracking where flesh is dark, Bl=blackening or very dark browning; O=no injury.

[2]Based on individual estimates for 5 tubers in each seedling variety and 10 tubers in each commercial variety

[3]Predominant or average kind of injury, increasingly more severe with yellowing, slate-color, browning, blackening, leaker effect, and cracking

[4]See 1 and 2 of "Literature Cited."

or seedling variety to another, the relative amount of injury as between varieties may change with the temperature of storage, and predisposition is inherited.

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RECENT SPRAY TESTS FOR CONTROL OF POTATO LATE BLIGHT IN SUB-TROPICAL FLORIDA

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The potato growing section located in South Dade County near Homestead, Florida, is a comparatively new potato producing area Between 6,000 and 7,000 acres are grown in mid-winter, practically all of the seed being planted during November and the crop harvested in February and March Bliss Triumph and Pontiac are the leading varieties

Several factors tend to make the control of foliage diseases difficult in this area. The potatoes are grown during the short days of winter rather than the long days of the northern summer growing season. Although rains are infrequent during the winter months, dew formation is usually very heavy, often beginning by 5:00 P. M. with the plants remaining wet until 10·00 A M. or later the following day. Growth of the tops usually is rapid and rank These conditions are very favorable for rapid development of plant diseases, particularly the downy mildews. More or less foliage injury commonly occurs following repeated applications of fungicides, especially bordeaux mixture and copper-lime dust.

Early blight was the only foliage disease of importance until 1935 when late blight appeared. Since 1938, late blight has been the most important foliage disease, although if Sclerotiniose (*Sclerotinia sclerotiorum* (Lib) DeBy) continues to increase in severity, it may soon replace late blight as the most serious foliage trouble. The terms early blight and late blight are misnomers when applied to the diseases caused by *Alternaria solani* (E & M) J. & G and *Phytophthora infestans* (Mont.) DeBy., respectively, as they occur in the Homestead section. Early blight is usually of little importance until late in the season as the plants approach maturity, whereas late blight may occur at any time after the plants appear above ground.

The potato flea beetle has not appeared in the area and leafhoppers are of no consequence on potatoes. Aphids are primary factors in reducing yields in some seasons. Cucumber beetles, army worms, and plant bugs are occasionally troublesome and in some years a serpentine leaf miner may cause considerable damage.

Field experiments for control of foliage blights of potato have been conducted annually since 1935 In the first three seasons, when late blight was a minor disease at the Station farm, it was unprofitable to spray or dust with copper fungicides for blight control. Various formulations of bordeaux mixture or copper-lime dust either reduced the yield

or did not increase it significantly. The use of various neutral copper sprays or dusts either had no effect on the yield or increased it insufficiently to be profitable. From the 1938-1939 season, when late blight first became of major importance, until the 1943-1944 season, all copper sprays or dusts used experimentally generally gave significant and profitable increases in yield. Wet sprays were more effective than dust treatments for blight control (2). The addition of zinc sulfate and hydrated lime to copper sprays reduced spray injury from these fungicides and in some seasons significant increases in yield resulted from the addition of the zinc salt When used with insoluble neutral coppers, the zinc salt causes flocculation of the suspended copper particles, decreases run-off and increases the initial deposit of copper on the foliage.

During the 1943-1944 season, the weather was moist and cool from the middle of November through December, and late blight was widespread and destructive by the 25th of December. In many fields it was well established on the foliage of the earliest plants to emerge before all of the sprouts had appeared above ground Under these conditions, control of the disease was unsatisfactory with copper sprays or dusts. Some growers failed adequately to check the disease although they sprayed twice a week, making a total of 14 to 16 applications during the growing season The average yield in commercial fields probably did not exceed 125 bushels per acre for the section as a whole, which was little more than half the average obtained during normal seasons. Under these severe late blight conditions, Dithane combined with zinc sulfate or zinc sulfate and lime gave such outstanding control in test plots as compared with copper fungicides that growers in the area adopted the new treatment almost without exception

The experiments with Dithane in comparison with other fungicides during the past three seasons, which produced results of particular interest, are discussed in this paper. Additional tests made for the purpose of screening out undesirable materials or combinations are not included herein.

The general procedure was as follows. All experiments were made on Bliss Triumph potatoes planted about the middle of November and harvested in March after the foliage was dead. Individual plots were 75 feet long and 4 rows wide, or approximately 1/46 of an acre and were planted with a single-row assisted-feed-type planter. The treatments were randomized and were replicated from 3 to 6 times in the various tests. The materials were applied with a tractor drawn power sprayer of standard make developing 400 pounds pressure which was equipped with a 4-row spray boom The various treatments were applied on the


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same day and were begun when the plants were 6 to 8 inches tall. They were repeated once a week or every 6 to 8 days for a total of 6 or 7 applications. Approximately 150 gallons per acre were applied from 3 nozzles to the row in the first two applications, 200 gallons per acre were applied from 4 nozzles to the row in the next 4 applications and slightly more than 200 gallons per acre were applied from 5 nozzles per row in the last application In addition, some exploratory tests were made in single-row plots planted by hand and the materials applied with a knapsack sprayer.

Presentation of Data

Table 1 summarizes the yield data from an exploratory test* on single-row plots 22 feet long, the treatments being replicated 3 times and applied 9 times, each with a knapsack sprayer during the 1943-1944 season.

TABLE 1 —*Results of spray test on potatoes with Dithane used alone and in combination with $ZnSO_4$ or $ZnSO_4$-lime, Homestead, Florida,* 1943-1944.

Materials	Formulas Pounds in 100 Gals Water	Bushels per Acre	Percentage of Yield in U. S No 1 Tubers
Untreated — Check		93 8	54 3
Dithane	2	163 7	76 7
Dithane	4	186 5	78 9
Dithane + ZnSO4	2-1	353.4	92 7
Dithane + ZnSO4	4-1	311 4	87 5
Dithane + ZnSO4-lime	2-1-½	325 4	90 8
Dithane + ZnSO4-lime	4-1-½	381 4	93 4

The data showed that the addition of zinc sulfate greatly increases the effectiveness of Dithane for control of potato late blight, as reported in 1944 (3). Some foliage injury appeared late in the season in the plots sprayed with Dithane-zinc sulfate without the addition of lime This was attributed to zinc toxicity.

Table 2 presents the data on the percentage of foliage killed by late blight 70 days after planting and the yields obtained from the treatments in the machine-sprayed experiment conducted in 1943-1944. As originally planted, the experiment included 13 treatments replicated 6 times each, but the development of seed-piece decay following several days of rain immediately after planting forced the abandonment of the plots.

*Conducted cooperatively with the late Dr L. L. Hill of the Röhm & Haas Company.

New plots were planted to include 3 replications of 7 treatments. Late blight was present in a mild form in all the test plots at the time of the first spray application.

TABLE 2—*Results of spray test on potatoes with Dithane-ZnSO$_4$-lime, Phygon, and copper fungicides, Homestead, Florida,* 1943-1944.

Fungicides	Formulas	Percentage of Foliage Killed by Late Blight, 70 Days after Planting	Bushels per Acre	
	Pounds in 100 Gals. Water		Total Marketable	Increase over Check
Untreated — Check		78	48	
Dithane—ZnSO4-lime	1 ½-1-½	6	304	256
Cuprocide—ZnSO4-lime	1 ½-1-½	19	203	155
Cuprocide—CuSO4-lime	1-1-½	21	180	132
Copper-Hydro 40	8	27	188	140
Copper-Hydro 40-ZnSO4-lime	8-2-1	32	135	87
Phygon	1	2	156	108

Dithane plus zinc sulfate-lime was the outstanding fungicide in the test. Although Phygon gave slightly better control of late blight, it was toxic to the plants and the yields were low. Bordeaux mixture was not included in this experiment but yields in commercial fields sprayed with this fungicide in the vicinity of the Station farm ranged from 100 to 200 bushels per acre in the 1943-1944 season and control of potato late blight was no better than in fields sprayed with Cuprocide or Copper-Hydro. Control of early blight was better with Dithane plus zinc sulfate-lime than with the copper sprays, confirming the results reported by Heuberger and Manns (1) in Delaware

In the 1944-1945 season approximately 95 per cent of the potato acreage was sprayed with Dithane-zinc sulfate-lime and potato yields were the highest on record for the section, averaging approximately 350 bushels per acre. Late blight was first observed on the 5th of January in a field where the potatoes had been sprayed 4 times with one of the insoluble copper sprays. A few days later it was found in several widely scrattered fields where the plants were either sprayed or dusted with copper fungicides, were imperfectly sprayed with Dithane, or were unsprayed Despite the cool weather, accompanied by considerable fogginess and several showers during January and part of February, late blight made surprisingly little headway and caused only negligible damage in fields sprayed thoroughly once a week with Dithane-zinc sulfate-lime. The growing life of the plants was extended several weeks and

growers with large acreages found it necessary to kill the tops with herbicides in order to begin harvesting operations on time. The new spray evidently prevented late blight from becoming epidemic and controlled early blight exceptionally well.

In the two machine-sprayed field experiments carried out on the Station farm, late blight appeared too late in the season to affect the yields seriously even on the untreated plots. The first test was conducted cooperatively with Dr. R. A. Hyre of Ohio State University. Treatments were replicated 4 times each and a total of 7 applications were made during the season. The results are summarized in table 3.

TABLE 3—*Results of spray test on potatoes in test 1, Homestead, Florida,* 1944-1945 (4 *replications, each treatment*).

Fungicides	Formulas	Percentage of Foliage Killed by Blight 90 Days after Planting	Bushels per Acre	
	Pounds in 100 Gals. Water		Total Marketable	Increase over Check
Untreated - Check		100	329	
Dithane-ZnSO4-lime	1.5-1-0 5	37	455	126
Na dimethyl dithiocarbamate-ZnSO4-lime	1 5-1-0 5	65	437	108
Methasan	1.5	87	415	86
Basi-Cop-ZnSO4-lime	4-1-0 5	84	407	78
Methasan-ZnSO4-lime	1.5-1-0 5	80	401	72
Bordeaux mixture	8-6	53	376	47
Basi-Cop-lime	4-8	96	376	47

Difference required for significance with odds 19 1=25 8 bushels
Difference required for significance with odds 99:1=35 1 bushels

All treatments significantly outyielded the unsprayed checks, and the Dithane-zinc sulfate-lime treatment significantly outyielded all treatments with the exception of the sodium dimethyl dithiocarbamate. However, at 90 days from planting date, late blight was more prevalent in the plots sprayed with the sodium salt than with Dithane, indicating that the difference in yield in favor of the Dithane-zinc sulfate-lime treatment probably would have been greater if late blight had appeared earlier in the season.

The results obtained in test 2 are summarized in table 4. In this test, treatments were replicated 6 times each and a total of 6 applications were made during the season.

TABLE 4—*Results of spray test on potatoes in test 2, Homestead, Florida,* 1944-1945 (6 *replications, each treatment*).

Fungicides	Formulas	Estimated Per cent Foliage Killed by Blight 90 Days after Planting		Yield in Bushels per Acre	
	Pound in 100 Gals Water	Late Blight	Early Blight	Total Marketable	Increase over Check
Untreated-Check		70	27	297	
Dithane+ZnSO4-lime	1 5-1-0 5	—1	1	384	87
AO-3	3	1	2	377	80
Copper Compound A	4	2 5	13	372	75
Zinc chromate #169	4	5	8	370	73
Copper Compound A-ZnSO4-lime	4-1-0 5	2.5	5	367	70
Zerlate	2	15	1	361	64
Dithane-Delmo-Z*	1 5-1	—1	1	355	58
A-O 3 + Phygon	2 5-0 5	—1	2	355	58
Copper-Hydro 40	6	3	20	351	54
Tribasic copper sulfate	4	2	25	346	49
Bordeaux mixture	8-6	2 5	3	345	48
Zinc chromate #298	4	2.5	3	313	16

Difference required for significance with odds 19 1=29 6 bushels
Difference required for significance with odds 99.1=42 2 bushels
*Neutralized zinc

All treatments with the exception of the zinc chromate No. 298 increased the yield significantly compared with the untreated checks. Dithane-zinc sulfate-lime gave the highest yield, which, however, was not significantly higher than the yields following AO-3, Copper Compound A, Zinc chromate No. 169 and Zerlate treatments. The substitution of Delmo-Z, a neutralized zinc compound, for zinc sulfate and lime for use with Dithane does not appear desirable for conditions in southern Florida. An injury to the foliage followed the use of Dithane-Delmo-Z which apparently favored *Sclerotinia* infection and a reduction in yield resulted.

Flooding by salt water during the 15th of September hurricane left heavy deposits of chlorides in the soil of the Station farm and the test plots were located during the 1945-1946 season on rented lands with shallower and drier soil. The growing season was one of the driest on record and on the shallow marls yields were cut drastically by drought.

Dithane-zinc sulfate-lime was used on practically all of the commercial acreage and despite the fact that late blight was epidemic on nearby tomatoes, a crop which is grown extensively in the Homestead

section, little disease developed on potatoes sprayed thoroughly and systematically with the Dithane-zinc spray Zerlate was used by a few growers but the results were not good with this material. Yields were low in some fields because of the presence of heavy chloride deposits and were high only in fields where the soil was deep, moist, free from dangerous amounts of salt and where the Dithane-zinc spray was used

Only a single test was made with various fungicides, some of which were combined with DDT, for control of foliage blights and insects of potatoes. Sixteen treatments were included and were replicated 4 times each and repeated once a week for a total of 7 applications.

Late blight was observed in the control plots during the first week of January, and 80 days after planting had killed the foliage in these plots It caused considerable damage in those sprayed with Zerlate and Dithiocarbamate IN-5445 but only minor damage in other plots and least damage in plots sprayed with Dithane-zinc sulfate-lime, Dithane-zinc sulfate Reaction Product and Dithiocarbamate IN-5446 The latter was received as a zinc-dithiocarbamate and was very similar in physical properties to the Dithane-zinc sulfate Reaction Product Early blight was present in all plots but killed practically no foliage except in the plots sprayed with copper fungicides and then only late in the season as the tops approached maturity. *Sclerotinia sclerotiorum* caused damage in all plots, but more in those sprayed with the dithiocarbamates than in those sprayed with copper fungicides, although none of the treatments gave commercial control of this disease

A serpentine leaf miner was prevalent and infestation was heaviest in plots sprayed with the dithiocarbamates Aphids (mostly *Myzus persicae*) caused some damage and reduction of yields late in the growing season The addition of ⅛ per cent DDT to Dithane-zinc sulfate-lime, Zerlate, Compound A, and Tribasic copper sulfate at each application gave almost complete control of these pests.

The yields and disease readings are summarized in table 5.

With the exception of the zinc chromate treatment, which caused a severe burning of the foliage, all treatments increased the yield, although in the case of Zerlate, Bordeaux mixture made with high calcium lime, Tribasic copper sulfate plus zinc sulfate-lime and Copper Compound A, the increases were not significant. The addition of DDT at ⅛ per cent to all applications of Dithane-zinc sulfate-lime, Zerlate, and insoluble copper fungicides further increased the yields, which increase in the case of Tribasic copper sulfate was significant. It seems probable that the yields from all treatments would have been much

TABLE 5.—*Results of spray test on potatoes, Homestead, Florida, 1945-1946 season.*

Fungicides	Formulas: Pounds in 100 Gals Water	Estimated Per cent of Foliage Killed by Blights 80 Days after Planting	Yield—Bu per Acre: Total Marketable	Yield—Bu per Acre: Increase over Check
Untreated - Check		100	171	
Dithane*-ZnSO4-lime	1 5-1-0 5	25	207	36
Dithane*-ZnSO4-lime + DDT ⅛%	1 5-1-0 5	22	225	54
Dithiocarbamate IN 5445	2	53	207	36
Dithiocarbamate IN 5446	2	25	208	37
Dithane-ZnSO4 Reaction Product	2	31	218	47
Zerlate	2	57	199	28
Zerlate + DDT ⅛%	2	50	205	34
Copper Compound A	4	34	199	28
Copper Compound A + DDT ⅛%	4	21	222	51
Tribasic copper-ZnSO4-lime	4-1-0 5	37	187	16
Tribasic copper-ZnSO4-lime + DDT ⅛%	4-1-0 5	32	218	47
Copper-Hydro 40	6	39	205	34
Bordeaux - calcic lime	8-6	34	184	13
Bordeaux - Magnesium lime	8-6	26	202	31
Zinc chromate #169	5	39	166	—5

Difference required for significance with odds 19 1=30 6 bushels
Difference required for significance with odds 99 1=56 2 bushels.
*In the 1945-1946 season liquid Dithane was used at 2 quarts—100 gals or the equivalent of 1½ pounds of dry disodium ethylene bisdithiocarbamate

higher if the severe drought had not occurred and differences between treatments and the control almost certainly would have been greater.

DISCUSSION AND CONCLUSIONS

Dithane-zinc sulfate-lime is the most reliable spray treatment for the control of potato late blight thus far tested in the subtropical Homestead section of Florida It also controls early blight very effectively and if properly mixed and used at 7-day intervals causes no visible injury to potato foliage Injury from the treatment may occur in Florida if lime is omitted, if neutralized zinc is substituted for zinc sulfate-lime or if the treatment is applied at intervals of 4 or 5 days Injury resulting from too frequent applications is less severe, however, than injury following repeated applications of copper fungicides at intervals of 4 or 5 days

When blight appears in epidemic form there is a tendency on the part of growers to hurry the spray job in order to cover the fields more frequently This is almost always accomplished only at the sacrifice of effective coverage and the grower defeats his purpose by doing this It has been our experience that when severe blight conditions prevail, better results will be obtained by adding more nozzles properly adjusted and driving the sprayer at a speed which will obtain maximum coverage.

Dithane-zinc sulfate-lime spray remains effective for 7 or 8 days on potato foliage, is an expensive treatment and is not very convenient to handle in the field We are watching with considerable interest the performance of the Dithane-zinc sulfate reaction product and the very similar zinc ethylene bisdithiocarbamate which can be shipped in a dry form and do not require the addition of zinc sulfate to the spray mixture There is also the interesting possibility that these new materials may prove effective when applied as dusts.

Dithane-zinc sulfate-lime in common with other dithiocarbamate sprays is wholly ineffective against Sclerotiniose and does not repel many of our important insects, although aphids appear to build up slower on potato foliage sprayed with them than with the copper sprays. Dithane-zinc sulfate-lime is compatible with DDT and the combination shows promise as an effective fungicide-insecticide.

Copper sprays or dusts still have a place in southern Florida. Much of the soil used for growing potatoes there is either deficient in copper or is so alkaline that copper is immobilized when applied to the soil as fertilizer A single copper spray or dust will supply this essential element under these conditions and in most seasons may be applied before blight becomes a serious problem.

The perfect fungicide for blight control has not yet been found and tests are being continued this year in an effort to find one better than Dithane-zinc sulfate-lime.

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SECTIONAL NOTES

CALIFORNIA

The harvesting of the early spring-planted crop in Kern County has been completed with 47,039 acres, yielding a harvest of 12,437,972 sacks,—an average yield of 264 sacks per acre.

At the present time, harvesting of the late crop of approximately 2600 acres is getting well under way in the Tehachapi area, at an elevation of approximately 4000 feet Harvesting in this area will be complete by the 15th of November

There is a very small acreage of new potatoes as we classify them grown in the floor of the valley. These will be harvested in December and January, and then lugged and sold in local California markets (Sept 3)—David N Wright.

NEBRASKA

Nebraska growers have faced a very erratic season, almost from the beginning As reported before, severe rain storms and floods occurred during the months of May and June, seriously affecting many crops throughout the state

The early crop in central and eastern Nebraska, usually planted in April, was seriously affected by the storms, and part of the crop was lost as a result Secondary effects were packing of fields, with a subsequent poor quality resulting One of the chief defects in the early crop was flea beetle damage, which usually is not troublesome. This may be accounted for by the inability of our growers to spray and dust at the proper time because of weather conditions

Most of the early crop has been marketed at this writing, with a very few lots remaining to be cleaned up. Early shipments deteriorated because of immaturity and some rotting caused by sun scald, consequently arriving on the market in poor condition A small percentage of the crop went to the Government at the beginning, but this was generally discontinued at the end of their shipping season

During the latter part of June and July, western Nebraska was hit by severe hail storms. In general, these storms did not affect the potato crop, since the plants in most instances were just emerging, whereas others were quite small. Although the effect was not apparent on the plants, the soil conditions became very poor, because of the abundant rainfall, which caused excessive packing and washing. After the middle of July, the temperatures changed radically from the cool, with excessive moisture, to the reverse. Since that time, which is a period of nearly seven weeks, there has been no general rainfall in the dry land areas of

western Nebraska. At the same time the heat has been intense, causing the ground to be dried and baked, making conditions unfavorable for quality production. Since the average frost date in western Nebraska is the 25th of September, the date when rainfall could relieve the situation is rapidly growing short. There is always the danger of an early frost with rainfall after the first of September. Therefore, our expectations of quality and yield are very pessimistic on the dry land territories at this time.

On the irrigated farms, which cover much of western Nebraska, both pump and stream irrigation, the situation is much better. Because of the heat, the set and size of potatoes are small, although there is time to correct this before harvest. Barring an early frost, the quality and yield of the irrigated crop should be near the average.

There are very few future sales made on either the seed or the table crop from the late territories. Most growers and shippers are optimistic about the price situation, because of the poor prospects for yield, and the decreased acreage that was planted in the late main crop of Nebraska (Sept 9)—MARX KOEHNKE.

NEW JERSEY

Approximately two-thirds of New Jersey's potato crop which is estimated at 13,260,000 bushels has been harvested. The yields have been very good in most sections of the state, the average yield for the state being estimated at 221 bushels per acre, an all-time high for the state

Approximately 7,000 carloads of 300 sacks each have been purchased by the government under the Price Support Program Nearly 4,000 carloads have been exported, mostly to Argentina, more than 1,200 carloads were converted into alcohol, 500 to cattle feed, and 476 cars placed in storage, and the balance has been converted into starch or used for dehydration or by institutions and the school lunch program Unless some radical change is made in the distribution of our crop, the industry will be swamped when government purchases cease next year. We must develop a program that will eliminate a glutted market and the resulting ruinously low prices for our product. The sooner this is done the better it will be for the entire industry.

New Jersey growers have entered slightly more than 300 acres of potatoes for certification this year. Approximately one-half of this acreage is devoted to the Katahdin variety. The hot, dry weather during the greater part of August and September has resulted in a slow development and a low yield is anticipated unless adequate rains come soon. (Sept. 19)—J. C. CAMPBELL.

NEW YORK

The crop in up-state New York, generally speaking, looks good considering the adversities through which it has passed. A late wet spring caused many sections of our fields to be drowned out and in some instances many seed pieces were lost. Blight started earlier this year than we have ever seen it, but with careful spraying and dusting it has been held in check by the growers who really fought to control it. DDT along with copper has also given a good control of insects.

Cobblers are now being harvested and a good crop is being reported. The late crop is apparently setting well and we can expect a good crop under normal conditions. However, the wet spring resulted in the roots being pretty close to the surface and the hot, relatively dry weather of August did some damage to them

Seed growers have good crops, generally speaking, with very low virus readings Our program for foundation stock seems to be showing good results. Some disappointment is expressed in getting some of the blight immunes and other new varieties certified because of the strictness of our certification standard and the fact that some of these varieties carry a virus disease. However, the blight-immunes are making a good showing in respect to blight and certainly show every indication of being very vigorous and high yielding Among these are the Placid, Virgil and Madison Teton, although not blight-resistant is being given a good trial and apparently showing up well for itself in a great many fields by a good set and is proving to be earlier than was at first expected. Ontarios are being given a trial this year especially in our scabby sections because it is hoped that this variety being scab-resistant, will help solve the scab problem for many growers.

Very little government buying is anticipated after the crop can go into storage. As yet, little interest has been shown by the dealers in signing up with the government but there still remain two weeks for the sign-up. (Sept 3.)—W J. EVANS

NORTH DAKOTA

Crop conditions in the Red River Valley are good Although the spring was very wet and backward, the season since then has been excellent and late plantings have pretty well made up for lost time Some digging has started and there is a little talk that yields are not going to be up to expectations, but it seems certain that the yield will be above the 125-bushel average carried in the crop report Many farmers are using defoliants in order to prevent oversize and hasten maturity There is a lot of burning and several different kinds of chemical defoliants

being used There are two new machines here that are being tested, both of which chew up the vines and drop them between the rows. This leaves a nice clean field for digging and harvesting. We'll know more about them shortly.

There is considerable talk in this area of a latent infection of mosaic that is hitting certified fields The Certification Service of North Dakota and Minnesota is watching this like a hawk and field rejections will be considerably heavier than expected The Seed Department of both states realizes that a reputation for good seed stock will be a more valuable asset in the future than it has been in the past, and they are determined that only the best shall pass It is difficult to tell at this time what our seed production will amount to.

This area will operate under a marketing agreement this season. The Control Committee of the North Central Potato Marketing Agreement covering North Dakota, Minnesota, Michigan, and Wisconsin, has already requested an order to restrict the shipment of culls. This will go into effect immediately, and every one is in favor of very rigid enforcement. This order will govern the sale of potatoes intra-state as well as inter-state

As a result of last year's rather extensive feeding demonstrations, conducted in this area by the Extension Services and this association, we feel that farmers will be much more willing to keep their culls at home. Last year's demonstrations showed potatoes having a real value when fed to any kind of livestock The Experiment Stations at both the University of Minnesota and the North Dakota Agricultural College are planning some intensive experiments this winter on the value of potatoes as a livestock feed These tests will cover both the feeding of raw and naturally dehydrated potatoes, which were dumped during the winter and allowed to freeze The discovery that this can be done here will be of considerable importance to all western states and may prove to be the answer of the by-product use for surpluses and low grades (Sept. 10.)—W. M. Case.

OREGON

There is considerable change in the potato crop situation here this year The total acreage planted for the Klamath Basin is about two-thirds that of last year; this year's acreage being approximately 16,000. In addition, much planting was done early in May, on particularly dry soil during warm weather, resulting in considerable seed piece rot This was followed by considerable wet weather causing development of rhizoctonia and this, in turn, was followed by heavy killing frosts the latter part of June. As a result we not only have a greatly reduced acreage but

stands are 15 to 20 per cent below normal and the crop is late The concensus of grower and dealer opinion here is that shipments will be about one-half of the average for the past three years and may not exceed 6,000 cars.

Klamath County is conducting a potato disease control program inaugurated in 1946 in cooperation with the State Experiment Station and local growers. The most serious problem is the control of insects such as peach aphids carrying virus diseases. Considerable progress was made on this in 1946 by dusting with DDT carrying a small percentage of oil or sulfur The two dusts that seem to be most effective in decreasing bug population in this area are D Fusol 4, which was found to be the best on experimental plots last year, and 5 per cent DDT with 2 per cent oil, which was considered second best. Additional trials with these materials or some variation from the originals are being carried out this year Bug counts seem to be greatly reduced in these fields and dusting with these materials is being accepted by a number of growers as a good method of control The Klamath Potato Growers' Association has adopted a 4-point program which they are publicizing and recommending to all growers in this area. These points are as follows: (1) Only seed of high quality should be used, preferably certified seed, and this should be thoroughly examined during cutting (2) No land should be planted that may contain voluntary potatoes or be otherwise unfit for production of top quality potatoes (3) All fields, certified or commercial, should be rogued sufficiently early to remove tuber perpetuated leaf roll plants or other diseased plants Second or third roguings may be necessary. (4) Dusting should be undertaken with materials developed here, as stated above, if there is any suspicion of current spread of virus diseases In addition, a 5th point is sometimes added which is: If virus disease, particularly leaf roll, current spread, is present in any quantity late in the season, fields should be defoliated to hasten maturity, harvested and immediately marketed before any necrosis may develop. It is believed by many growers that this program will be very helpful in preventing the spread of virus diseases and consequent deterioration in quantity and quality of potato production in this area The general program is supervised very closely by Walter Jendrzejewski, Assistant County Agent here, and Joe Schuh, consulting entomologist whose services are provided by county appropriation and Dr John Milbrath, Assistant Pathologist in charge of potato diseases at Oregon State College. We believe this program is bearing fruit

I might add that our acreage of certified seed has been reduced to some extent but to date a very high percentage has met field tests and

it is possible that we may have more seed meeting certification requirements than was the case last year. After completion of certification here samples are grown in the Oceanside test plots in southern California further insuring seed stock free from disease (Aug 28)—C A. HENDERSON

PENNSYLVANIA

Late blight is widespread and causing considerable loss on unsprayed or poorly sprayed potatoes. The following chemicals, Dithane, Fixed Coppers, and Bordeaux at the 8-4-100 strength have given satisfactory control when applied in sufficient amounts to cover the foliage. Our prospects are now good for an excellent crop on all well-sprayed fields. (Sept 9.)—O D BURKE

SOUTH DAKOTA

Potato digging has started in this area and the yield varies from fair to good. There was very little rain in July and August so the yield will be below that of last year. Estimates are for a yield varying from 75 to 175 bushels per acre. The stock that is being harvested now is being washed and sold to local wholesale houses and truckers A few cars of certified Bliss Triumphs were shipped last week to Southern Florida.

There were 6,350 acres entered for certification this year compared with more than 7,000 acres last year. Rejections by the field inspector were very low since the majority of the seed planted was foundation stock shipped in from Wisconsin, Minnesota and North Dakota

The seed this year will be about the size most desired by the growers. Our growers are planning to store the largest portion of the certified stock for winter delivery.

A referendum on a potato marketing agreement for the potato producing area in South Dakota will be held soon. The order has been published in the Federal Register and the final date for filing exceptions was the 2d of September. It is not expected that any action will be necessary by the committee, when appointed, on the 1947 crop since prices offered at the present time are well above support levels. (Sept. 9.) —JOHN NOONAN.

VERMONT

Indications, as of the 8th of September, point to a much smaller yield per acre than in 1946. Late planting caused by excessively wet spring conditions gave a bad start. Late blight, together with drought conditions in August, cut growth in many fields.

About 415 acres were entered for certification with "Kats" and

Green Mountains accounting for a greater part of it. Houmas were the only others in any considerable acreage.

Very little virus disease was found and nearly 400 acres passed the second field inspection. No ring rot had been located to date during this season.

Whether or not because of the rather general use of DDT or for natural reasons, aphids were in general less abundant (Sept 11.)—HAROLD L. BAILEY

MAINE

Every one, of course, is wondering about the production of the crop in Maine I have no reason to question the government estimates, which will be revised on the 10th of September, for over a period of years these figures have been accurate. The southern end of Aroostook has experienced a severe late blight epidemic. The central and northern part has had some blight, but it has not affected the yield as yet We are two weeks late, not only in our digging operations, but also regarding the size of the crop Usually at this time of year less than a thousand acres have been harvested.

The use of DDT and the late season make it certain that vine killing must be generally practiced by most farmers in order to harvest their crops without danger of the green tops spreading blight and later causing bin rot Practically every known top-killing material is being used in the county Most of these chemicals are giving good results especially when a thorough coverage is secured Sulphuric acid is being applied through custom work, but indications point toward the fact that the machines are not standing up under constant usage

About 98 per cent of the farmers stayed within their average allotments When it came to paying a cent for a hundredweight as a service fee, some farmers did not agree to do so. It is believed, however, that about 90 per cent of the farmers will eventually become eligible for price support under the AAA program.

Requests for approximately 500 Canadian workers have been made by farmers through the Farm Labor Office It is expected that most orders can be filled Digging will become general about the 22d of September (Sept 9.)—VERNE C BEVERLY.

WASHINGTON

The Washington certified White Rose seed potato growers began their harvest as usual immediately after the 1st of September. The first seed harvested is being shipped to Argentina, South America By the end of the harvest season at least 50,000 crates of White Rose will be

shipped to the Argentine The White Rose growers are harvesting normal crops, averaging approximately eight tons per acre

There were 1,111 acres of seed potatoes that passed field inspection for certification Eight hundred ninety-five of these were White Rose, the remaining acres being Netted Gems and other miscellaneous varieties

The market for certified seed is good and the demand will no doubt increase during the next several months. Foundation seed will be scarce and will no doubt bring approximately $5.00 per cwt for Blue Tag this winter.

This past year over 6,000,000 sacks of potatoes from Idaho, Oregon and Washington, were used at the Northwest Dehydrating plant at Lynden, Washington, in supplying 1,640,000 pounds of dehydrated potatoes for the European relief program (Sept. 8.)—HAROLD S. SCHAAD

CANADA

Applications for field inspection of potatoes with the view of certification have increased from 7,896 in 1946 to 8,067 in 1947. The increases occurred in Prince Edward Island and British Columbia, respectively. On the other hand, the acreage entered is reduced from 66,665 in 1946 to 58,502 in 1947 In Manitoba the increase amounted to 232 acres, and in Saskatchewan to 16 acres All other provinces showed decreases. (Aug. 15)—J. W SCANNELL

ANNUAL MEETING

December 28-29-30, Chicago, Illinois

As announced in the August issue of the Journal, the annual meeting of the Potato Association of America will be held at the Palmer House, Chicago

The committees as listed in the August issue have been changed somewhat and a final list will be printed in the October issue It has been decided also to change the joint session with the American Society for Horticultural Science from Tuesday afternoon to Wednesday morning

All copies of manuscripts or titles of papers should be submitted to Marx Koehnke of Alliance, Nebraska, on or before October 10 in order to be included in the official program of the American Association for the Advancement of Science

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NEW BLIGHT-RESISTANT VARIETIES

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The primary purpose of this article is to record in a readily accessible place technical descriptions of hybrids which have emerged from a program of work designed to develop new varieties which are immune to the blight caused by *Phytophthora infestans* The general methods employed have been described in a previous issue of this *Journal* (20. 118) and need not be repeated here. Likewise, details of method are to be found in a subsequent issue of the Journal (22. 357) in connection with a description of the variety Empire. Particular attention is directed to the discussion in the latter paper under the heading "stability of blight-proof character "

The method of introduction of these varieties is partly one of necessity and partly one of design "Necessity" is based on the well established fact that there are areas in New York where it is difficult or quite impossible to produce seed potatoes because of the high incidence of virus diseases While it may never have been demonstrated conclusively there is an impression generally extant that areas in the immediate vicinity of experiment stations are "hot beds of infection" for all kinds of plant diseases In any case, it is very difficult to keep stocks of potatoes free from virus diseases in the environs of Ithaca As soon as a hybrid gives some indication of possessing commercial value it is taken to areas in the state where seed stock is produced regularly and in general to the farms of growers who have a consistent record of year after year "certification" Much sorting of hybrids continues on

these farms with eventual yield testing of outstanding sorts Growers are given title to the stock that is brought to their farms This is "design" It establishes an interest that is most helpful in making a final decision about naming a variety The grower contributes his knowledge of the commercial aspects involved and having seen the variety emerge he is in a better position than any one else to get the variety into commercial production in the shortest possible time There is no evidence at all, and none was expected, that any of the collaborators have given a thought to the temporary monopoly they may enjoy In some instances monopoly actually exists at the present time because some hybrids may be dropped in one locality and not in another

In some instances the decision to drop a particular hybrid in a specific locality may have been nothing more than a mistake, but in other cases it was pretty certainly a matter of regional adaptation, and in still other cases the farm economy of the community has been a factor It will be noted in the case of some varieties described here that little is known of their adaptation outside the restricted area in which they emerged The varieties can be grown to advantage in these restricted areas and they will be grown there until something better appears They will, therefore, get a local name or names It has seemed better to introduce such varieties under a single name and thus make them identifiable both locally and in a wider sphere in case any of them prove to be useful

Empire

Released for increase, January 1945
Described in Amer Potato Jour 22 357-362 1945.

Empire was tested again on the south fork of Long Island in 1946 and in the absence of a bridging variety developed foliage blight late in the season Unsprayed Green Mountains in the same plot had been dead for over a month with blight Tuber rot was found on Empire as well as on Green Mountain It is known that the tubers of Empire and of many of the hybrids have little or no resistance to blight It is not known whether the tubers of Empire became infected from Green Mountain plants or from its own blighted foliage but in any event the organism has emerged from such tubers in virulent condition It would appear that the use of Empire should be discouraged While it is possible to discourage its use there is no way now to suppress the variety It is in the hands of the general public and will be used or dropped on the basis of other characters than resistance to blight. In the seed-producing areas the growing season is shorter than it is on Long Island and blight usually becomes prevalent much later in the season Either

frost or a chemical vine killer would terminate growth before immunity breakdown, hence no infection. This is, of course, too tenuous a thread on which to hang one's hope of a permanent suppression of potato blight but it is a stopgap which can be employed with caution until such time as a substitute variety can be selected The most serious aspect of the situation appears to be that Empire may be the means of raising the level of virulence of *P. infestans* so that other varieties already "released" will not continue to be immune.

It is relatively easy now to produce thousands of hybrid seedlings which give an immune reaction when inoculated with *P. infestans* It is easy to see that among the plants lying below the threshold of infection there are varying degrees of resistance It is therefore inferred that such differences occur among the plants lying above that line and breeding behavior of some such plants certainly supports the inference.

In the cool and moist season of 1946, Empire has responded to the favorable conditions and has given higher than average yields just as was true for standard varieties The production of tubers of too great size is a definite fault of the variety. The fault can be overcome to a considerable extent by planting the seedpieces 7 or 8 inches apart in the row Also, from the commercial standpoint the tubers have too few eyes for machine cutting and this results in missing hills and consequent production of oversize tubers

PLACID

Released for increase at Buffalo meeting of Empire State Potato Club. January 1946.

Origin

The variety Placid is one of the many hybrids produced in the past several years in an endeavor to develop a blight-proof variety for commercial production. The fantastic chart of parentage illustrates throughout the gropings of the earlier efforts and to some extent the often repeated remark that in the end one takes what he can get. The name is taken from a well known lake in the Adirondacks where the variety first attracted attention in the variety tests conducted on the farms of the Lake Placid Club.

DESCRIPTION OF PLACID

Habit. Plants emerge as several stalks which remain erect until they are 40-60 cm. tall after which they spread and become large and dense with much growth of axillary shoots; stems sturdy, thick, green throughout, solid except near tips where there may be a cavity 1-2

- Placid (DAC/1)
  - ABX/6
    - Alma
    - DL/1 ♂
      - 860 ♂
      - 672/19
        - Smooth Rural
        - 178 (demissum) ♂
  - AFY/5 ♂ F_2 < JV/7 selfed
    - 822
      - 483
        - 100 F_2 < 277
          - 178 (demissum)
          - 167 (Fendleri) ♂
        - 364 (Silhonetta)
      - 289 (Imperia) ♂
    - 851 (Katahdin) ♂

mm. in diameter, very scant white hairs; wings inconspicuous, green, knife edge; nodes not swollen, green; internodes short, 3-6 cm; stipules small, 10-15 mm., short, clasping; leaves compact, short, 16-24 cm., dark green throughout; petioles short 3-4 cm., sparse white hairs; midrib green throughout, leaflets usually 3 pairs, elliptic to oval, acuminate tip, moderately rugose, scant short white hairs, mean length of blade 74.98 ± 959 mm., mean width 45 33 ± .495 mm., index 60.714 ± .41; folioles fairly large, leaf-like, sessile, usually one pair between each pair of leaflets, often also an additional pair of tiny ones between some or all of the pairs of leaflets.

Inflorescence. Short 6-10 cm., medium branching, 3-8 flowers; peduncles green, flattened, sparse fairly long white hairs; pedicle extra long 2.5-3 cm., green, paler green distad of the articulation, sparse long white hairs more abundant distad of articulation; articulation not swollen, evident only by a ring of hairs and the change in color of pedicle; calyx pale green, fairly long subulate teeth, sparse white pubescence; corolla rotate, lavender, the sinus a mere notch, teeth short acuminate, white inside but whitish externally with brownish, pyramidal shields on each lobe; stamens rather short, bright orange, locules inconspicuous; pollen moderately fertile; style short, barely exceeding the anthers, white, cylindric; stigma capitate, greenish, small, globular; seedball globular, pale green with a few white submerged spots at stylar end; seeds nearly white, abundant.

Tuber. Weight and measurements based on 100-tuber sample. Mean weight 279.4 ± 8.136 gms.; mean length 101.95 ± 1 386 mm.; mean width 80.45 ± 2 596 mm; mean thickness 57 97 ± 636 mm., index (width to length) 79 886 ± 964; index (thickness to length) 57.265 ± 822; index (width to thickness) 72.393 ± 698; sprout not colored in dark, sprout color in light vinaceous drab, skin warm buff (R); eyes, fleet, eyebrow, inconspicuous, flesh white; boiled tuber white, fine grain, mashes down smooth, moderately mealy, good flavor, maturity midseason, matures with Katahdin; storage, little or no apical dominance, rest period, breaks early.

Characteristics

Placid, as grown in the field, gives a very favorable impression at all times Several stalks emerge promptly and because of the compact growth cover the ground early The stems approximate determinate growth and remain erect until maximum height is attained. Thereafter they go down and may become nearly or quite prostrate but the profuse development of axillary shoots still gives the impression of an upright plant.

The variety has been subjected to both hot (90° F.) and to dry weather. It has exhibited some resistance to both conditions. A combination of these conditions causes a physiological roll of the leaflets which is not particularly confusing because most or all of the leaves roll. They do not have the hard brittle "feel" of the leafroll caused by virus

The set of tubers, the growth period and maturity date correspond rather closely with the variety Katahdin. The tubers are not so smooth and bright as Katahdin They do not hold their shape as well as Katahdin in years of drought followed by excess moisture.

Placid pleases the growers because there are plenty of well distributed eyes and particularly because there is almost total lack of apical dominance so that every eye produces a good strong sprout.

Cooking quality has ranged from moist and slightly mealy to dry and mealy, and from good to excellent flavor

Reaction to Diseases

Repeated inoculation of vigorously growing plants with *P. infestans* (Cornell Lab. culture virulent for the hybrid AAB-2) has resulted in an immune reaction. Infection has been observed with inoculation in greenhouse and field apparently from blighted Empire. Infection by means of senescent leaves has been established in greenhouse tests

Early blight (*Alternaria solani*) was noted one year by W. R. Mills at State College, Pa.

Inoculation with virus X by means of a grafted scion from Rural New Yorker gave no reaction Placid is considered passive but its carrying capacity of acronecrosis is unknown.

When inoculated by grafting with a "severe" virus X taken from Katahdin a brilliant mosaic develops.

Inoculation with virus Y by graft inoculation results in a very indefinite mosaic. In subsequent clonal generations the mosaic is indefinite or not discernible at all Immediately following 48 hours of continuous rainy weather diseased units in a tuber-unit plot were easily detected by their yellowish color. This method is not effective on a warm, dry day. The disease causes a definite dwarfing of plants, a symptom which is only moderately useful in eliminating diseased plants. Presumably the yield of tubers is affected adversely but how great this may be is not known. The presence of even a trace of the disease in the variety is most undesirable because of the ease with which aphids can pick up virus Y and communicate it to susceptible varieties In the greenhouse the disease can be detected best in January and February under natural light when the mosaic pattern ranges from indefinite to

clearly discernible. The leaflets show considerable rugosity, and the margins of unfolding leaflets are wavy.

Placid is susceptible to common scab and to leafroll but it is not known how readily it picks up the latter disease

Adaptation

In New York, Placid appears to be the most widely adapted of any of the hybrids thus far tested. It is early enough to mature in the short season of the Adirondack area and in the long season of Long Island. It has been grown on several different types of soil and has given satisfactory yields on all of them. It withstood an outbreak of blight near Maracay, state of Aragua, Venezuela, 480 m. elevation, about 11° n. latitude but was grown in too limited amount to state definitely that it could be produced there economically.

Dissemination

All of the stock of Placid is in the hands of seed producers and is being increased by them just as rapidly as possible All of the available supply of the 1946 crop was engaged on the day the variety was released. It is, therefore, useless to make known the names of growers until the end of the 1947 season. For some unknown reason, Placid stands in greatest favor with seed growers. Many of them have seen the experimental plots, most of them have seen exhibition tubers, and some have studied yield data although in no case do these data cover more than 3 years of test.

VIRGIL

Released for increase at Buffalo meeting of Empire State Potato Club. January 1946

Origin

Virgil is a plant in third backcross stage from a collection of *Solanum demissum* made at El Desierto, D F, Mexico in 1930. As can be seen from the diagram it represents straight backcrossing and is the best method known for prompt results The first cross was made May 28, 1931, and yielded 7 seeds The first backcross made in June 1932, second backcross in May 1934; third backcross, May 1939 The hybrid ZH-2 was non-receptive in 1938 but in 1939, 6 of 12 trials yielded seeds and as the plants were considered much too late in maturity date they were dropped In the third backcross Krantz' seedling 15-2 conferred much needed earliness.

- Virgil (CYJ-1)
  - 1145 ♂
  - ZH-2
    - 1W-1
      - 378 ♂ (Pirola)
      - 812
        - 378 ♂ (Pirola)
        - 534 (demissum)
    - 860 ♂

Description of Virgil

Habit Plants emerge as several sturdy erect stalks which become 50-60 c. tall, thereafter spreading but maintaining a semi-erect position, stems green throughout, thick, fleshy, pubescence very sparse consisting of short curved white hairs, wings not prominent, wavy, green throughout; nodes slightly thickened, not colored, internodes short 3 5 to 6 cm., hollow, the tubular cavity about 3 mm. in diameter; stipules small, reniform, clasping, leaves short, 17-23 cm. long, compact, petioles short, 4-5 cm. long, faint vinaceous coloration in channel which fades out in midrib but is accentuated at junction of leaflets and extends a short distance in the midvein, leaflets mostly 4 pairs, sessile, short stalked to 8 mm, pale green with an oily sheen, extremely rugose from the beginning, flat elliptic with acuminate tip and undulating margin, with age, terminal leaflets roll slightly and develop vinaceous coloration on under side at the tip, pubescence very inconspicuous existing as very short white bristles Mean length 62 ± .5 mm.; mean breadth 37 1 ± 3.4 mm ; leaf index 59 97 ± 43, folioles numerous, leaf-like, 1 pair at base and 1 pair between each pair of leaflets with usually an additional pair or 1 or 3 small sessile ones.

Inflorescence Erect, short 9-10 cm, sparsely branched, 10-12 flowers in the cluster; peduncle green throughout, slightly flattened, sparse very short white hairs; pedicle fairly long 2 to 3 cm., green, sparse short fine hairs; articulation a slightly swollen vinaceous ring; calyx pale green, short, short acuminate tip, corolla large, diameter from tip of lobe to sinus opposite 26-32 mm, lavender, rotate, short acuminate teeth, very shallow sinus, becoming strongly reflexed, stamens orange, exposed only after corolla opens, pore present, inconspicuous, evident as two vinaceous spots in dehisced anthers; pollen moderately fertile, style long, cylindric, extruded before flower opens, stigma small green capitate, seedballs globular, dark green, immaculate.

Tubers Mean weight 295 07 ± 7 571 gms ; mean length 104 13

± 1.208 mm; mean width 84 48 ± 767 mm., mean thickness 57 44 ± 661 mm., index (width to length) 82 037 ± .888; index (thickness to length) 55.954 ± 861, index (width to thickness) 68 177 ± 785, sprout color in dark, uncolored except tips of terminal and lateral leafscales rhodonite pink (R), sprout color in light, uncolored except tips are drab (R); maturity slightly later than Placid but in general about like Katahdin.

Characteristics

Virgil, like Placid, presents a fine appearance in the field from the beginning. It continues nearly erect throughout the season and approximates a determinate type of growth. This type of growth makes for ease in applying insecticides. The strongly rugose foliage, a characteristic inherited from Krantz' seedling 41-2-10-1, makes the variety easy to identify The pale greenness of foliage is not paler than Green Mountain Heat and drought tolerance, likewise originating with Krantz' seedling, is superior to Placid and approximates or equals that of Empire. Physiological leafroll has not been recorded in the years 1941-1946.

The shape of the tuber is not outstandingly attractive and the eyes are deeper than one could wish. Cooking quality, so far as it has been tested, is perhaps the best of any of the varieties here described. Growth cracks or knobs have not been noted in the variety The number and distribution of eyes and lack of strong apical dominance are characters which appeal to the grower

Reaction to Disease

There are certain indications that Virgil lies farther over the threshhold of blight incidence than does Empire or Placid even though some blight on green leaves was encountered on Long Island in 1946 In any event the perpetuation of a virulent form by perennation in tubers is unlikely because of maturity date. The variety is susceptible to rugose mosaic and reacts typically—severe vein and stem streak, acropetal necrosis, severe mosaic in subsequent clonal generations.

Virgil is, at least, passive to acronecrosis (virus X) as determined by grafting on a scion of Green Mountain, a carrier variety. Leafroll resistance has not been determined other than to note that leafroll has been recorded for only two plants in the years 1940 to 1946. The variety is susceptible to common scab.

Adaptation

Virgil has been widely tested in New York. It is at its best in the central plateau area and gets its name from a village in southern Cort-

land County. In some areas of the state it is exceeded by Placid and very significantly so in the Adirondack area. It is very well adapted to the dairy country of central New York where acreage on individual farms is small and where potatoes are for the most part strictly a secondary crop.

Dissemination

As in all other cases, the entire stock of Virgil is in the hands of seed growers. They are increasing stock as rapidly as possible and have sold almost exclusively to other seed producers so that there should be a moderate supply available to the general public in the autumn of 1947

ASHWORTH

Released for increase at Buffalo meeting of Empire State Potato Club, January 1946.

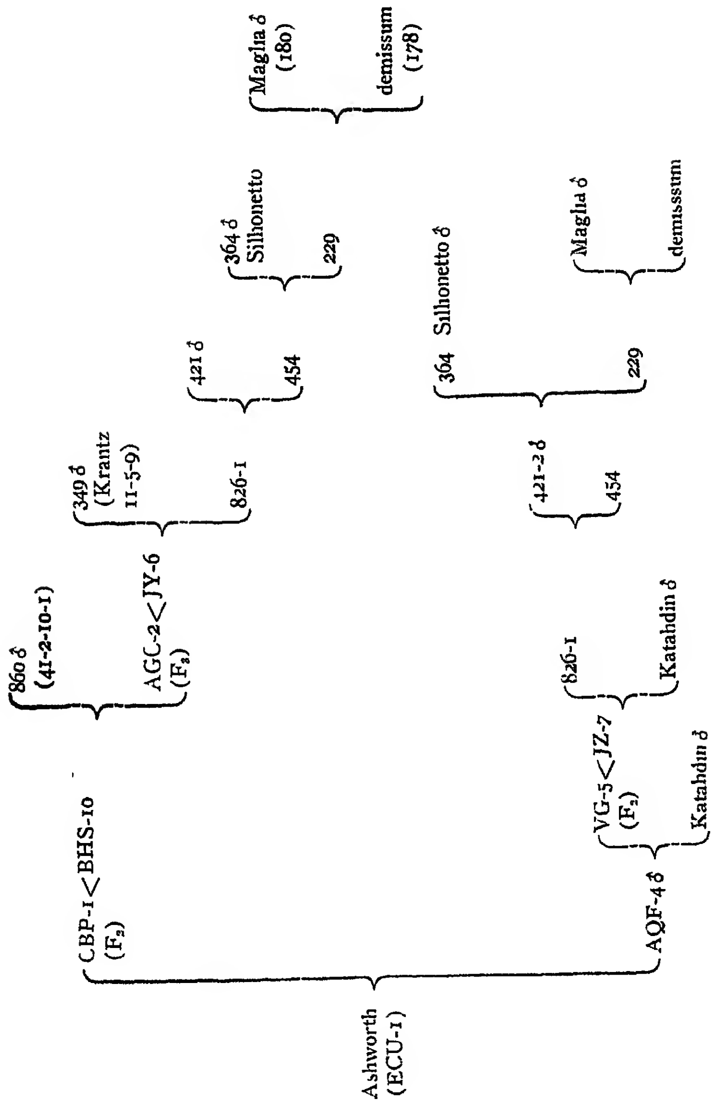
Origin

The chart of parentage for Ashworth illustrates again the gropings of early efforts in the production of blight-proof varieties No significance, whatsoever, is to be attached to the method employed. The immune parent is *Solanum demissum* (#178) the original seedling plants of which were contributed by Fred L. Ashworth, Heuvelton, N. Y., in the spring of 1928. The variety is named for Mr. Ashworth a self-educated farmer and philosopher whose avocation is a search for frost tolerant plants of economic importance. Mr. Ashworth not only supplied seedlings from which it was determined that the species is immune but has also been of much assistance in testing various seedlings. He has very mild interest in the commercialization of his finds

Some elucidation of parents indicated in the chart is needed *S maglia* (180) is not a good species but rather a heterozygous variety indigenous on the Island of Chiloe Silhonetto (Sylvan X Hindenburg) is a variety obtained from P T Knappe in Esthonia in 1929. No. 421-2 (U.S.D A, S 43572 X S. 42667) is an unnamed seedling which was selected from a lot of plants grown from seeds contributed by C F. Clark The plant produced an abundance of fertile pollen and was particularly useful because it was relatively early in maturity. Nos. 349 and 860 are unnamed seedlings obtained from F A Krantz under the numbers 75 25-5-7 (in 1936 Krantz renumbered this 11-5-9) and 41-2-10-1.

DESCRIPTION OF ASHWORTH

Habit Short spreading plants 50-60 cm tall, determinate, stems sturdy, angular, thick, stiff, green throughout (Ashworth farm) or with pale vinaceous coloration at base (Carpenter farm), studded with


Ashworth
(ECU-1)
CBP-1 < BHS-10
(F3)
AQF-4 ♂
860 ♂
(41-2-10-1)
AGC-2 < JY-6
(F3)
VG-5 < JZ-7
(F2)
Katahdin ♂
826-1
Katahdin ♂
349 ♂
(Krantz
11-5-9)
826-1
421-2 ♂
454
421 ♂
454
364 Silhonetto ♂
229
364 ♂
Silhonetto
229
Maglia ♂
demissum
Maglia ♂
(180)
demissum
(178)

very sparse short white hairs, wings inconspicuous or none, green; nodes not swollen, not colored, internodes short, 4-6 cm ; stipules leaf-like, clasping, large, sessile, especially if axillary shoot has pushed; leaves large, open 23-30 cm. long, dark green throughout; petioles 5-9 cm long, channel shallow, green; leaflets 3 or 4 pairs, dark green, elliptic, somewhat rugose, acuminate tips, short (4-6 mm) stalked, mean length 74 89 ± 86 mm , mean width 45.64 ± 58 mm , leaf index 61.0 ± 14, folioles usually lacking.

Inflorescence Tall, erect, medium branching, 8-12 flowers in cluster, no leafy bract, peduncle nearly cylindric, 9-10 cm., fairly dense very short white pubescence, pedicle long, green, cylindric, pubescence as on peduncle, articulation inconspicuous, not colored, calyx lobes green, awl-like, sparse short white hairs, corolla white with pale lavender shield on inside of each lobe, rotate, shallow cleft, sharply acuminate teeth; anthers yellow to orange, short, pores distinct, but not marked by color; pollen scant to none, occasionally fertile; style long, cylindric, extruded before corolla opens; stigma small, globular.

Tuber Mean weight 265 97 ± 6 973 gms , mean length 90.18 ± 1 117 mm , mean width 90.09 ± 1 009 mm ; mean thickness 55 26 ± 6 mm., index (width to length) 100 636 ± 1.326, index (thickness to length) 61 886 ± 817, index (width to thickness) 61 689 ± 701; sprout uncolored in dark or light, skin warm buff (R), eyes, fleet, eyebrows, inconspicuous; flesh, white, maturity, slightly earlier than Katahdin.

Characteristics

Ashworth is an open, determinate, erect plant and remains erect until mature. The variety has been subjected to both hot and dry weather With heat alone the leaflets show physiological roll and crinkling of leaflets Terminal leaflets, particularly ones that roll, sunburn and show purplish coloration on the exposed lower side In 1943 a year of extreme drought at State College, Pa , W R Mills found that despite appearance Ashworth was seventh in total yield in a lot of 72 hybrids and fourth in yield of marketable tubers

The tubers approximate Katahdin in size, shape and appearance but the large tubers tend to be rough and the eyes at the bud end are rather deep

The cooking quality is equal to or superior to Katahdin In several cases the variety has been rated extra good, dry and mealy

Reaction to Diseases

Ashworth has been subjected to natural spread of blight in the

field and has never shown any disease.[1] It has been inoculated with a virulent culture (Cornell Lab culture infective on hybrid AAB/2) of the organism in the greenhouse and gave an immune reaction Its behavior upon inoculation of senescent leaves is not known.

The variety is passive to virus X as indicated by negative reaction with a grafted scion of Russet Rural, a carrier of virus X, and also passive to virus Y by graft inoculation It is susceptible to leafroll

Adaptation

The variety has been developed in St. Lawrence County, New York, an area where potato production is strictly secondary to the dairy industry. It matures satisfactorily in the short growing season of the area and its apparent immunity to blight makes it particularly useful there because very few farmers feel justified in owning suitable equipment for satisfactory blight control by spraying the vines Tests in other parts of the state were interrupted early by the incidence of leafroll in the stocks, but the limited tests made recently suggest that the variety may have wider usefulness than is now known The ability to produce a crop under extremely dry conditions, as indicated by the trial in Pennsylvania in 1943, is a factor of considerable importance in many places

Dissemination

Ashworth is available in extremely limited amounts at present and will be increased rather cautiously until more is known about the adaptability of the variety and particularly until something more is known about a sib which may eventually prove superior to it

CHENANGO

Released for increase at the Buffalo meeting of Empire State Potato Club, January 1946.

Origin

Chenango is another variety developed at the Cornell University Agricultural Experiment Station in an attempt to effect permanent control of potato blight by the use of the natural immunity of *Solanum demissum*. As in many cases the pedigree shown in the chart has nothing to commend it. The original cross *demissum* x *fendleri* was made Aug. 1, 1928. This interspecific hybrid was made with the original intention of determining the mode of inheritance of blight immunity. All of the plants in the second generation (family 400) were immunes and

[1]On Sept 15, 1947 blight was found on the last few dying leaves of Ashworth.

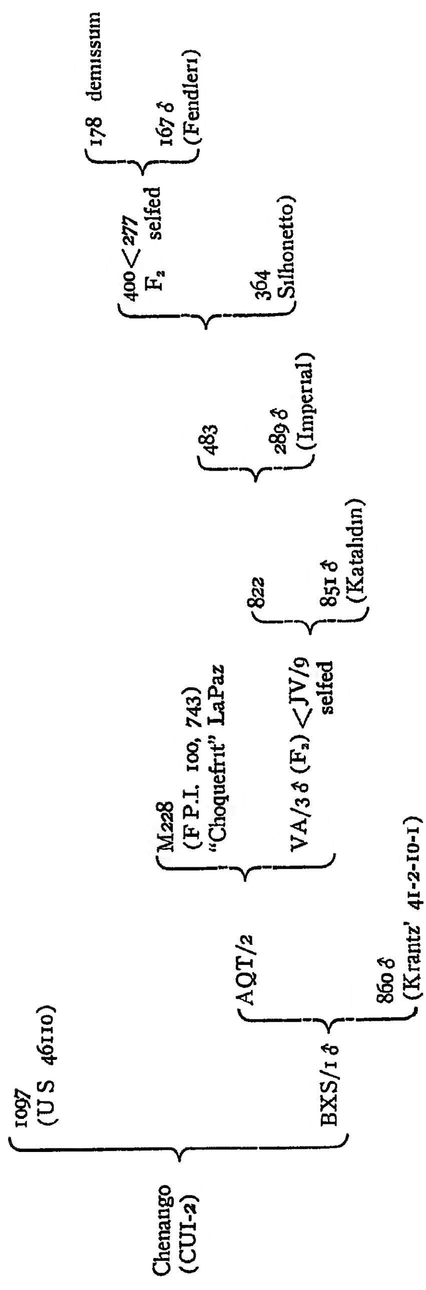
all of them had exactly the appearance of the female parent, *S. demissum*, so that while certain facts were ascertained they did not give an answer to the original question. So far as is known nothing was lost or gained by using a plant of the family 400 over the use of the original *S. demissum* in making the cross with Silhonetto except that the flowers were available in that case and were not available in the case of No. 178 or any other specimen of *S demissum*. The hybrid, JV-9, received some consideration as a possible commercial variety but was eventually discarded because of purple skin-color. The selfing of JV-9 and growth of progeny (VA family) was done primarily to determine whether there would be a reversion to wild type after a second backcross. The reversion did not occur in this instance Selection No. 3 being a self-fertile plant was tested to find out whether an immune hybrid in this state of dilution from the wild immune could be used as a male parent and thus bring into the program many of the commercial varieties most of which had proved non-receptive to the pollen of *S. demissum*. One-third of the trials were successful thus helping to decide the question favorably but the use of "Choquefrit" from LaPaz was essentially fortuitous in that flowers happened to be available for the purpose on June 1, 1935 AZT-2 was a large late plant, as might have been anticipated. exhibiting tolerance for drought and for frost, self-fertile; but the skin of the tubers was variegated, mostly purple but with clear white areas about each eye BXS-1 was a self-fertile plant, which set far too many tubers on longish stolons but the tubers had white skins. In the light of present knowledge, it was used prematurely but doubtless was used because of its fertile pollen. There is nothing in the records up to this point to suggest that an "earliness" factor was present. The earliness of Chenango seemingly must have come from the other side of the family even though "1097" (U.S D.A., 46110) is a main-crop variety at Ithaca According to E S Schultz the variety (46110) is nearly passive to virus Y

The pedigree of Chenango illustrates exceptionally well some of the exploratory probings that have been made since 1928 and the detailed recital of this case history will make it unnecessary to explain in such detail the pedigree charts of other varieties for which descriptions are now being constructed

The name is taken from the name of the county of New York in which the variety was developed. It has no connection whatsoever with the old variety Black Chenango

Description of Chenango

Habit Plant emerges as one to several weak stalks, becomes 35


Chenango
(CUI-2)
1097
(U S 46110)
BXS/1 ♂
AQT/2
850 ♂
(Krantz' 41-2-10-1)
M228
(F P.I. 100, 743)
"Choquefrit" LaPaz
VA/3 ♂ (F_2) < JV/9 selfed
822
851 ♂
(Katahdin)
483
289 ♂
(Imperial)
400 < 277 selfed
F_2
364
Silhonetto)
178 demissum
167 ♂
(Fendleri)

to 45 cm tall, then spreads and becomes nearly prostrate, fills by the abundant development of axillary shoots; stems straight, angular, medium thick, green throughout, very scant short white hairs; wings inconspicuous disappearing distally, green, knife edge, narrow; nodes slightly swollen, green, internodes short, 3-5 cm., solid; stipules a petiolate pair, small, short, clasping; leaves light green, large, short, 20-22 cm., open, petioles fairly long, 5-7 cm, channel shallow, midvein green; leaflets usually 4 pairs, dark green, smooth on short petiolules, 4-10 mm, elliptic, with acuminate tips, scant white, very short pubescence, mean length of blade 59 7 ± 7 mm, mean width 37 2 ± 42 mm, leaf index 62 4 ± 26; folioles usually present but varying from none at all to 1 or 2 pairs, or 2 pairs or even more between each pair of leaflets and occasionally one pair on the petiolules.

Inflorescence Short, 8-12 cm, medium branching, 10-12 flowers, peduncle short 6-8 cm, green, flattened, scant white hairs, articulation very inconspicuous, colorless; calyx green, subulate tips, scant short white hairs; corolla white, rotate with deep clefts and short teeth; stamens small, short, lemon yellow, pore a faint orange line showing only with age, pollen none, style twice as long as stamen, pale straw color, cylindric; stigma globular or inconspicuously 2-lobed

Tuber Medium elliptic to roundish with blunt ends, rather thick, mean weight 240 43 ± 6 909 gms.; mean length 91 10 ± 1 162 mm, mean width 77 91 ± .731 mm, mean thickness 56 36 ± .629 mm; index (width to length) 85.488 ± 1 396, index (thickness to length) 61.21 ± 861, index (width to thickness) 71.392 ± 751; sprout uncolored in the dark, sprout color in light, light vinaceous drab (R), skin cream buff (R), smooth; eyes shallow, same color as skin; eyebrows moderately prominent, curved; flesh white, boiled tuber white, slightly mealy, good flavor, maturity early

Characteristics

The outstanding characteristic of Chenango is its early maturity in which it is comparable with Cobbler and Chippewa. The stems are weak and the plants become prostrate Both heat and drought cause a physiological leafroll There is a strong tendency to set too many tubers with the result that in dry seasons too few tubers reach commercial size The tubers are much smoother than Cobbler and approximate Chippewa in skin and eye characters

Reaction to Disease

Chenango is immune to late blight in greenhouse tests (Cornell Lab culture virulent on AAB-2) and in field plots Even if infection can

be induced as in the case of Empire previously noted there is relatively little chance that the variety would become infected because the plants mature before late blight commonly becomes prevalent in New York State

A scion of Green Mountain, carrying virus X, was set on Chenango but the axillary shoots which pushed from the stock appeared perfectly healthy The variety is considered passive, at least, to acronecrosis The variety is susceptible to leafroll and to virus Y Common scab has not been observed on the tubers but no tests for scab resistance have been made

Adaptation

In New York, the tests so far conducted indicate that Chenango will be restricted to the area in which it was developed Dr. A. J. Pratt has grown the variety on an acre basis in Chenango County and his neighbors there are growing it Doctor Pratt, through his work with 4-H clubs, will presently have extensive data on adaptation.

The variety is suited to the agricultural conditions of the area in which it was developed and will be grown locally, at least, until something better is found One name for the variety seems better than the half dozen names that inevitably would spring up even in the confines of a single county

Dissemination

In accordance with practice the surplus stock of Chenango is in the hands of collaborators. In this instance and for the planting season of 1947 the one collaborator who has appreciable surplus is Doctor A. J. Pratt

Other Varieties

At the Rochester meeting of the Empire State Potato Club, January 1947 other varieties were released for increase These include Essex (DAB-3), an early maturing sort, Madison (DUY-2), a second early, Snowdrift (DDD-10), an early, Cortland (DFC-1) a main-crop variety, Fillmore (CRH-3) and Harford (CSF-11) both late varieties. Several other hybrids are making a substantial record to date and will be disposed of one way or another within one or two years more

The authors have no compunction about introducing new varieties. The "trade" is inclined to favor a few standard varieties and seed growers are more strongly so inclined because it reduces the danger of varietal mixture. Nevertheless, there are dozens of varieties of potatoes grown in New York in the so-called non-commercial areas and some of them are as old as Early Rose while still others, like Lady Finger, are over a

hundred years old. In any new variety the really crucial test comes only when it is in the hands of the general public. The real sorting of varieties can come only then. The general public will determine which names are to stand and which will be relegated to obscurity or extinction

COLLABORATORS

The persons who have collaborated in this work have contributed not only time, land and labor but also have furthered the work materially by expert advice on the whole problem of potato production. Their names are appended.

All of the increase stock for 1946 was in the hands of these men Many of them deal almost exclusively in carlot orders and do not like to bother with small lots. All of them, however, have been willing to fill orders for experimental purposes and to sell to other seed growers Some offers to buy the entire surplus in one transaction have been rejected Each individual has the privilege of setting any price he chooses on his stock. The 1946 selling price actually has been only a little higher than was charged for tuber-unit, foundation stock. In the autumn of 1947 these persons will still have most of the surplus but many other seed growers will have small quantities available: Fred Ashworth, Heuvelton, New York, Kennard Carpenter, R D 1, Dryden; H. J. Evans, Georgetown; Wm Hodnett, Fillmore; Edw. L. Kent, Andover; George Mehlenbacher, Wayland; A J Pratt, Agri College, Ithaca; Favor Smith (Lake Placid Club Farms), Lake Placid; J. A O. von Sopp, Skaneateles; Wm Stark, Chestnut Ridge Road, Glens Falls; George Webster, Chestnut Ridge Road, Glens Falls

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PERMANENCE OF GREENING OF POTATO TUBERS

DONALD FOLSOM[1]

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Greening of potato tubers by light causes losses during the preparation of the tubers for cooking or dehydrating It may affect color descriptions of new varieties and of surface and cortical diseases It is claimed to be correlated with a development of solanin, a poisonous alkaloid. Greening may occur in the field, in storage, and in the market It is of interest to know whether any greening fades out under any conditions. This question is mentioned only rarely in the literature In Montana, "the color will usually disappear from green potatoes after they are stored in darkness for several weeks, unless the greening is very pronounced" (3, p. 40)

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[1]Head of Department of Plant Pathology

Chippewa, Katahdin, and Green Mountain tubers from a Maine field were used for a greening and fading experiment in the fall and winter of 1946-1947. The tubers were washed, numbered with an indelible pencil, and grouped by threes in each variety Each group was exposed to light for a given period and then kept in the dark for a while, except that some were peeled and sliced up at the end of the greening period, and a few had become partly green in the field and were not greened further. The dorsal surface[2] of each tuber was the one exposed to light each day, and was used for judging color. Color was judged under "Daylight" fluorescent lamps according to Ridgway (4) and Maerz and Paul (2). A few tubers were exposed to light from fluorescent lamps similarly in cool and warm rooms and showed that under the same lighting conditions greening occurred more slowly at 40° F than at 70° F. Otherwise the tubers were greened in a rather cool greenhouse room by natural light only in the period from the 16th of October to the 15th of November. The three varieties greened at approximately the same rate.

Results of the test are given in tables 1 and 2 with respect to observations of the greened surface. The longer in the light, the more pronounced became the green. Storage in the dark was generally characterized by the development of more red, showing as pink or brown shades. In spite of this, which might mask slight changes in the green, there was evident some fading of the green in 31 days after the 2- or 4-day greening This fading occurred faster in the warm storage.

Sprouts were inhibited in the warm storage after the 31-day examination by coating the tubers with a dust containing the methyl ester of alpha-naphthalene-acetic acid. This dust had no effect upon the work otherwise, judging from uncoated control tubers, being washed off for each examination for color. After another month in the dark there was no appreciable change in the green from the color at the end of the first month, and there was still generally more red than at the beginning of storage in the dark After a further storage of three months in the dark, there was little change at approximately 35° F., but at 75° F the color had become darker brown.

Subepidermal greening was noted upon sectioning the cortex at the end of the greening period and after a week, a month, and 5 months in the dark After 2 days' greening there was very shallow cortical greening, which became lighter in warm storage than in cool in 31 days

[2]The surface that is more convex and contains more eyes, and that usually is uppermost in the soil (1, p 6).

TABLE I.—*External color of tubers of three varieties after exposure to late autumn light in a greenhouse*

Days in Light	Color Developed					
	According to Ridgway			According to Maerz and Paul		
	Chippewa	Katahdin	Green Mountain	Chippewa	Katahdin	Green Mountain
0	XVI Cream	XXX Cream buff	XXIX Cinnamon buff	9-E-2	11-E-3	11-F-5
2	XVI Naples yellow XXX Colonial buff	XXX Colonial buff, deep colonial buff	XXX Deep colonial buff	11-G-2	11-H-3	11-H-3
4	XVI Naples yellow, olive lake XXX Deep colonial buff	XXX Olive ocher	XXX Olive ocher	11-H-3	12-G-3	12-F-3, 12-H-4
7	XVI Olive lake	XVI Olive lake, dull citrine	XVI Olive lake, yellowish citrine	12-K-2	12-I-2, 13-J-2, 13-J-3	12-I-3, 12-J-2; 12-K-1
14	XXX Ecru olive, light yellowish olive	XXX Buffy olive	XXX Ecru olive XXX Olive yellow, light yellowish olive	13-H-4, 13-J-2, 13-J-3	14-I-1, 14-J-3, 14-K-3	12-L-1
31	XXX Yellowish olive XXXI Kronberg's green	XXXI Kronberg's green; jade green	XXXI Rainette green	22-I-1, 22-I-3	22-H-1, 22-H-4, 22-I-1	21-K-3, 21-K-4

TABLE 2—*Color changes in surface of greened tubers in dark*

Days in Light	Changes in Dark[1]							
	In 7 Days		In 31 Days		In 2 Months[6]		In 5 Months[7]	
	Cool[2]	Warm[3]	Cool	Warm	Cool	Warm	Cool	Warm
2	More red except in Kat	More red except in Kat	Less green, more red	Less green[4], more red	More red	More red	More red in Chip and G M	Darker brown in Chip and Kat
4	More red	More red, except more green in Kat	Less green in Chip.; more red	Less green in Chip[5], more red	Slightly more red	More red	Lighter in G M	Darker brown
7	G M. more red; others greener	Some more red	More red in Chip.	More red in Chip	Somewhat more red	More red	No change	Darker brown
14	Slightly lighter gr in Kat.	Slightly lighter gr. in Kat.	More Red in Chip, G M darker	G. M darker	More red in G M	More red in Chip and G M	No change	Darker brown
31	—[8]	—[9]	More red, Kat darker	—[9]	—[8]	—[9]	No change	—[9]

[1]From colors given in Table 1 Three sets of samples
[2]At about 35° F.
[3]At about 75° F
[4]More loss of green below skin than in cool storage
[5]More loss of green below skin than in cool storage, in all varieties
[6]Green same in 2 months as in 31 days.
[7]In comparison with color after 2 months in dark Same tubers
[8]No examination at this time.
[9]No samples.

and which in 5 months disappeared in warm storage in all varieties and in cool storage in Chippewas.

After 4 days' greening there was very shallow cortical greening which was more pronounced in Katahdins than in the other varieties, which faded more in warm than in cool storage in 31 days, and which disappeared in warm storage in Chippewas and Green Mountains in 5 months.

After 7 days' greening the cortical greening reached a depth of about 1/16 inch in Katahdins but was very shallow in the other two varieties Here temperature in the dark had no effect in 31 days but in 5 months the cortical greening was still distinct in cool storage. After 5 months in warm storage, the cortical greening was absent in Chippewas, faint in Green Mountains, and a shade less pronounced in Katahdins than in cool storage.

After 14 days' greening and a week in the dark, cortical greening was more pronounced in Katahdins than in the other two varieties. Then after 31 days in the dark, temperature had had no effect, but after 5 months in the dark, there was slightly less greening in the warm storage than in the cool.

After 31 days' greening or after field greening, 5 months of cool storage left the cortical green still very marked

Conclusions

Potato tubers greened faster at ordinary room temperature than in a cool place. Greening, as seen through the skin, faded faster in the dark at 75° F. than at 35° F., faded somewhat in a month of dark storage after 2 to 4 days' exposure to light, faded in 5 months only in the warm storage after 7 to 31 days' exposure to light, and was obscured or replaced by red or brown when fading in dark storage. Cortical greening developed faster and faded less in Katahdins than in Chippewas and Green Mountains, faded faster in warm than in cool storage, and faded less after longer exposure to light Culinary tubers if exposed to light for 2 days may require over a month in warm dark storage for fading of the green, and if exposed to light for longer periods may require several months of warm dark storage for fading of the green.

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VIRUS X IN THE NEWER POTATO VARIETIES AND THE TRANSMISSION OF THIS VIRUS BY THE CUTTING KNIFE[1]

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INTRODUCTION

In New York State, mosaic potato plants have appeared recently in fields of the relatively new potato varieties, Katahdin, Sebago, and Chippewa These varieties are known to show either field resistance to the viruses causing mosaic in the older American varieties or to react with symptoms differing markedly from those observed in these fields. As these three varieties constitute a large percentage of the potatoes grown in this state and in some other potato-growing regions of the United States, it was thought worthwhile to identify and to study the virus or viruses responsible for this mosaic disease and to examine the possible means of transmission in commercial stocks.

Mosaic symptoms are known to be caused by any one of several distinct viruses or a combination of two or more. In the older American varieties the mosaic diseases most frequently encountered are mild mosaic and rugose mosaic The former disease is caused by potato virus A[3] and is characterized by mottled areas of variable size and shape located over the surfaces of the leaves without regard to the veins. However, since these older varieties of potatoes are 100 per cent infected with virus X[4] it is impossible to determine the exact symptoms attributable to virus A infection alone Sebago, Katahdin, and Chippewa have been shown to be highly resistant, if not immune, to virus A under field conditions (Stevenson and Clark, 1938, and Clark *et al*, 1933).

The principal causal agent of rugose mosaic, which affects both the old and newer varieties of potatoes, is the veinbanding strain of potato virus Y[5] Here, too, the presence of virus X in all the older American varieties of potatoes makes it impossible to determine whether the symptoms of these varieties result from virus Y alone or from virus X and virus Y together. The newer varieties and unnamed seedlings are also susceptible to virus Y and may cause symptoms varying from a very mild

1 An abstract of the thesis, from which this material was taken, was pubished *In* Cornell University Abstracts of Theses, pp 168-170 Cornell University Press, Ithaca, New York, 1946

2 Assistant Professor of Plant Pathology.

The author is indebted to Professor F M Blodgett for advice and encouragement throughout these studies.

3 Solanum virus 3 Smith, *Marmor solani Holmes.*

4 Solanum virus 1 Smith, *Marmor dubium Holmes*

5 Solanum virus 2 Smith, *Marmor cucumeris* var. *Upsilon,* Holmes.

mottle to severe veinal necrosis and leaf drop even in the absence of virus X. Mosaic symptoms caused by virus X alone have been reported or Chippewa (Larson, 1943). Jones, Vincent, and Burk (1940) reported that when Katahdin was inoculated with virus X from older varieties of potatoes, no symptoms resulted, but when infected with a virus of the X type from a seedling potato plant, a definite mottling of the foliage occurred.

At the present time there is much controversy as to whether potato virus B is a strain of virus X or a separate virus. Virus B has not been shown to cause symptoms in either the older or newer American varieties of potatoes when the plants are grown from infected tubers. It has been shown, however, to be present in the older American varieties of potatoes as evidenced by top necrosis resulting when these varieties are grafted to certain European varieties (Murphy and McKay, 1932, and Dykstra, 1935)

Determination of the Virus Present

The first problem was to determine the identity of the virus causing the mosaic symptoms in the varieties Katahdin, Sebago, and Chippewa. A number of differential hosts or indicator plants was used as an aid in this identification. Virus X causes distinctive symptoms in related species, including *Datura Stramonium* L., *Lycopersicum esculentum* Mill., *Capsicum annum* L, and *Nicotiana tabacum* L. (Johnson 1925). Numerous workers have substantiated these results and also have shown that different strains or types of virus X give different symptoms on these indicator plants However, only on pepper are symptoms produced by all known strains.

Potato seedling 41956[6] does not contract virus X but readily contracts virus A (Schultz *et al*, 1934) and virus Y (Stevenson *et al*, 1939) and under suitable conditions these viruses produce characteristic symptoms. Virus B causes top necrosis whereas Virus X causes a mottle or no symptoms in the variety Arran Victory (Murphy and McKay, 1932).

Procedure:

Fifty-five mosaic plants of the variety Katahdin, five of the variety Sebago, and 18 of the variety Chippewa were grown in the greenhouse from tubers of mosaic plants collected from fields throughout the state. Symptoms occurring on these plants were noted at all growth stages.

Preliminary inoculations to pepper plants indicated that virus X was present in all of the mosaic plants. In order to substantiate these results and to gain an approximation of the type of virus present, me-

6 U S D A seedling

chanical inoculations were made from each of these plants to duplicate sets of three young and vigorous plants of Datura, tobacco, tomato, pepper, and the potato variety Katahdin. The tubers produced by the Katahdin plants were replanted.

The method of making mechanical inoculations was briefly as follows the leaves to be inoculated were dusted with #400 carborundum and then rubbed gently with sterile cheesecloth pads dipped into juice obtained by triturating leaves of the source plant with a sterile mortar and pestle In making routine inoculations from potato plants to indicator plants for the purpose of determining the presence or absence of virus X a more rapid method was used. In this method a potato leaf was plucked from the plant and folded into a tight ball by means of a large pair of forceps The folded leaf was triturated against the rough side of a pot label and then rubbed on the leaves of the plant to be inoculated.

Grafts of the cleft type were made using scions from the 78 mosaic plants and plants of the seedling 41956 as stocks. Each graft was successfully completed two or more times. The grafted plants were observed for eight weeks

Cleft grafts were also made to plants of the potato variety Arran Victory to test for the presence of virus B. Since Arran Victory may carry a mild strain of virus X with no symptoms (Salaman 1938), the plants to be used as stocks were tested for virus X by inoculations to pepper plants This procedure was followed in assuring X-free potato plants for all experiments

Results:

The symptoms on all of the indicator plants showed that virus X was causing the mosaic symptoms in all of the Katahdins, Sebagoes, and Chippewas. This evidence was substantiated by the results of serological tests [7] Juice of Datura plants infected with the virus obtained from one of the potato plants showing a brilliant mottle as well as that from plants infected with one of the mild types gave positive precipitin reactions with an antiserum prepared with Johnson's ringspot strain of virus X.[8]

The fact that no symptoms appeared in the plants of potato seedling 41956 indicated that neither virus A nor virus Y was involved. The absence of top necrosis on any of the grafted Arran Victory plants revealed that virus B was not present in any of the mosaic plants. There was no evidence of the presence of a new virus on any of the inoculated or grafted plants

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7 Performed by Professor A F Ross of the Department of Plant Pathology, Cornell University, Ithaca, N. Y

8 This ringspot strain was supplied by Dr L O Kunkel, Rockefeller Institute for Medical Research, Princeton, N. J

TABLE 1.—*Reaction of potato and indicator plants to infection with the X virus.*

	Katahdin from Diseased Tuber	Pepper (Mechanical Inoculation	Tobacco (Mechanical Inoculation)	Datura (Mechanical Inoculation)	Tomato (Mechanical Inoculation)	Arran Victory (Graft)	41956 (Graft)
Mild X	Latent or very faint mottle	Systemic necrosis; leaf fall	No symptoms or a very few yellow flecks and a faint mottle	No symptoms or a very faint mottle, sl. V.C.,* sl. V.B.,** very few superficial necrotic spots	No evident symptoms	No symptoms or a very faint mottle. No top necrosis	No symptoms
Medium X	Medium mottle; occasionally scattered necrotic spots	Systemic necrosis; leaf fall; necrosis of stem	Medium mottle; med V.B.; few necrotic ring spots; many necrotic lines and flecks	Medium mottle, med V. B., med. V C; few superficial necrotic spots	No evident symptoms	Medium mottle; very few necrotic spots; leaves slightly rugose; no top necrosis	No symptoms
Severe X	Brilliant mottle; distorted leaves; pronounced V. B; scattered necrotic spots; plants stunted	Systemic necrosis; leaf fall; pronounced stem necrosis	Brilliant mottle, many necrotic rings and many necrotic flecks; intense V. B.; plants greatly stunted	Numerous necrotic spots and necrotic areas; brilliant mottle; highly rugose; intense V.C, plant greatly stunted	Few necrotic spots on inoculated leaves; brilliant systemic mottle	Brilliant mottle; scattered necrotic spots, leaves distorted; plant stunted; no top necrosis	No symptoms
Necrotic X	Brilliant mottle; distorted leaves; innumerable necrotic spots; plant stunted	Entire plant dead	Many necrotic rings on all leaves, some leaves dead; plant greatly stunted	Necrotic spots and areas on all leaves; some leaves dead, highly distorted leaves; plant greatly stunted; entire plant may be killed	Very numerous black, necrotic spots on leaves; some leaves killed, entire plant may be killed	Very numerous pinpoint black necrotic spots on leaves; mottle; leaves distorted, plant stunted; no top necrosis	No symptoms

*Veinclearing **Veinbanding

The original 78 mosaic plants were divided into four groups on the basis of symptoms as follows:

	Symptoms	Name Assigned to Causal Agent
Group 1	Very faint mottle	Mild X
Group 2	Medium mottle	Medium X
Group 3	Brilliant mottle	Severe X
Group 4	Brilliant mottle with many pin-point necrotic spots in light colored areas	Necrotic X

The border lines between these types are not sharp: the division is made in this manner only for convenience in presenting the material (table 1). There was no evidence to indicate that all plants in a given group were infected with a single strain of virus X. It is more probable that several strains were involved, possibly in the same plant.

When inoculations were made from these 78 plants to Datura, the Datura plants showed a range of symptoms typical of virus X infection and closely paralleling in severity those on the potato from which they were inoculated Symptoms of varying degrees of severity were also noted on the tobacco, tomato, and pepper plants. These symptoms likewise paralleled in severity the symptoms on the potato plants from which the inoculum was obtained.

The majority of the diseased plants found in the field were infected with the medium type of virus X (table 2). Since only those plants

TABLE 2—*Number of plants found in the field infected with the several types of virus X.*

Variety	Mild X	Medium X	Severe X	Necrotic X
Katahdin	15	36	3	1
Sebago	1	3	1	0
Chippewa	4	10	1	3
Total	20	49	5	4

showing a mottle in the field are represented this cannot be taken as an accurate picture of the types of virus X infecting these varieties. In other experiments involving inoculations to indicator plants, it was found that many symptomless plants of these three varieties were infected with a mild type of virus X.

Mechanical and Graft Inoculation to Healthy Potato Plants

Since the symptoms resulting from the inoculations from virus diseased potato plants to healthy plants often aid in diagnosing the

disease, it was thought worth while to study the reactions of healthy potato plants to mechanical and graft inoculation with virus X as found in the mosaic plants of Chippewa, Sebago, and Katahdin. Green Mountain plants which are infected with both virus X and virus B were also used as inoculum to give a comparison of symptoms attributable to viruses X and B in combination as well as to virus X alone.

Smith (1933) reported healthy Katahdin potato plants infected with virus X by mechanical inoculation first showed circular necrotic lesions on the inoculated leaves followed by a mild mottling of the top leaves, the remaining leaves developing a network of necrotic lines more pronounced on the lower surfaces of the leaves than on the upper. Schultz *et al* (1934) reported that with tuber graft inoculations from Green Mountain to healthy Katahdin tubers, top necrosis of the Katahdin plants resulted Identical results were obtained when shoot graft inoculations were made (Schultz and Raleigh, 1936). Evidence has been presented that Katahdin shows no necrosis when graft-infected with virus X, but reacts necrotically to graft infection with virus B (Cockerham, 1943).

Procedure:

Mechanical inoculations were made from each of the 78 mosaic plants collected in the field to two actively-growing X-free plants of each of the varieties Katahdin, Sebago, and Chippewa In addition, mechanical inoculations were made from two Green Mountain plants to five healthy plants of the varieties Katahdin, Sebago, and Chippewa.

Successful grafts were made from each of the 78 mosaic plants collected in the field to at least two healthy X-free plants of the varieties Katahdin, Sebago, and Chippewa Grafts were also made from Katahdin plants infected with mild X, medium X, and severe X and from Green Mountain plants to X-free plants of 9 other varieties (table 3) The Green Mountain scions, infected with a mild type of virus X in addition to virus B, and the Katahdin scions, infected with the different types of virus X each came from plants which were progeny of single hills.

Symptoms on all inoculated plants were observed and recorded during an eight-week period To test for the successful transmission of mild virus X, reinoculations were made to Datura and pepper plants.

Results:

Virus X was transmitted to approximately 95 per cent of the mechanically inoculated plants and to all of the plants on which successful grafts were made.

On approximately 40 per cent of the plants mechanically inoculated from mosaic Katahdin, Sebago, and Chippewa plants the first symptoms

TABLE 3.—*Results of grafting to X-free varieties of potatoes.*

Variety Used As Stock	Green Mountain* X-and B-infected	Katahdin Mild-X-infected	Katahdin Med X-infected	Katahdin Severe X-infected
Katahdin	Slow developing top necrosis	Mild mottle or no symptoms	Medium mottle	Brilliant mottle
Sebago	Severe top necrosis	"	"	"
Chippewa	Some necrotic spots on terminal leaves Only a very few leaves of terminals died.	"	Medium mottle Leaves ruffled	Brilliant mottle Leaves ruffled
Sequoia	Severe top necrosis	Mild to medium mottle	Brilliant mottle	Very brilliant mottle
Pontiac	"	No symptoms	Medium mottle	Brilliant mottle
Ontario	No symptoms	No symptoms or a faint mottle	"	Brilliant mottle Leaves ruffled
Seneca	Severe top necrosis	Mild mottle or no symptoms	"	Brilliant mottle
Cayuga	No symptoms	No symptoms or a slight mottle	Faint to medium mottle	"
Empire	No symptoms	No symptoms	Medium mottle	Brilliant mottle
Menominee	Severe top necrosis	"	"	"
Norkota	Severe top necrosis	Faint mottle or no symptoms	Faint-medium mottle	Very brilliant mottle
Erie	Severe top necrosis	No symptoms	Medium mottle	Brilliant yellow mottle

*All Green Mountain scions used came from plants shown to be infected with virus B by grafting to Arran Victory.

were black necrotic spots (1-4 mm. in diameter) appearing on the inoculated leaves These spots were more frequent when the severe and necrotic types of the virus were used (50 per cent) than when the mild type was present (20 per cent). No correlation was evident between the presence of these spots and the successful systematic transmission of the virus

Systemic symptoms occurred first on young leaves and then spread to other leaves of the plants. In all cases the mottling that appeared on the new growth of any particular plant was very similar to that appearing on the plant from which the inoculum came. With approximately 60 per cent of the inoculated plants a mottle was the only symptom

When mechanical inoculations were made from Green Mountain plants a faint mottle, typical of a mild type of virus X, appeared on the inoculated plants The presence of virus B in the Green Mountain plants did not appear to alter the symptoms

When diseased Katahdin, Sebago and Chippewa scions were grafted to healthy X-free Katahdin, Sebago, and Chippewa plants symptoms

developed similar to those in plants from which the scions were taken. No top necrosis occurred, thus providing additional evidence of the absence of virus B in the original mosaic plants.

From table 3 it can be seen that the chief differences in the reactions of the different varieties to the scions used were in those cases where Green Mountain scions containing the viruses X and B were used. Seven of the varieties tested developed top necrosis The development of top necrosis on the Katahdin variety was slow The reaction in the Chippewa variety consisted of the appearance in the apical leaves of numerous necrotic spots, which occasionally coalesced and caused death of the apical portion. When this occurred the necrosis extended only a short distance down the stem. On the other hand no symptoms were obtained on the varieties Ontario, Cayuga, and Empire, although mechanical inoculations to pepper and grafts to Arran Victory showed the presence of both viruses X and B

In the grafts from the X-infected Katahdin plants, all of the varities reacted in essentially the same manner: that is, with mottle symptoms in the case of the severe and medium types of virus X, and no symptoms or a very faint mottle as a result of infection with mild virus X. The mottles caused by both types of the virus X were more brilliant on Sequoia than any other variety. In all varieties, the severe virus X caused the most intense symptoms, medium virus X intermediate, and mild virus X the least intense

Transmission of Virus X by Means of the Cutting Knife

Since virus diseases are not commonly transmitted through the true seed, potato plants may be considered to be free of virus X when grown from seed.

No insect vector has been established for virus X. Dykstra (1933) and Dykstra and Whitaker (1938) have carried out the most extensive experiments in the search for an insect capable of transmitting this virus.

It is generally considered that seedlings become infected by means of foliage contact with X-infected plants Schultz *et al* (1937) and Loughnane and Murphy (1938a) have shown by controlled field and greenhouse experiments that virus X can be transmitted to adjacent healthy plants in this manner. Numerous virus workers, including Bawden (1942), have expressed the belief that foliage contact will not account for all infections in the field

Loughnane and Murphy (1938b) did not obtain transmission of virus X by root contact Roberts (1946) obtained some evidence of transmission in this manner. However, he obtained only one successful transmission.

Consequently, it appeared desirable to find out if virus X could be transmitted from tuber to tuber by means of a cutting knife. Valleau and Johnson (1930) in a discussion of the means of which virus X is transmitted, state that transmission by this means had not been accomplished. Apparently no recent work on this subject has been reported in the literature

Procedure

For the inoculum two sets of tubers, each originating from one hill in the field, were selected. One set was shown to be infected with a mild type of virus X and the other with a severe type of virus X. Sprouted X-free tubers of the varieties Katahdin, Sebago, and Chippewa were cut into four seed pieces with a sterile knife. Three of these seed pieces were inoculated by one of two methods. In method A, a sprout (⅛-¼ inch long was injured with a knife contaminated by cutting through a virus-infected tuber. In the case of method B, a knife contaminated in the manner described above was used for cutting a ¼ inch slice from the healthy seed piece. Great care was taken to avoid cutting through a sprout. An uninoculated seed piece was planted from each tuber. Inoculations were made to pepper plants from plants arising from these uninoculated seed pieces as additional evidence that only X-free tubers were used. All plants from an infected tuber were discarded Seed pieces were planted immediately in separate pots spaced so as to prevent contact of the leaves of adjacent plants as the plants grew

Since the severe virus X used causes a brilliant mottle on all the varieties of potatoes used in this experiment, the plants from seed pieces inoculated with this type of virus X were examined daily for symptoms. In order to make certain that a mild type of the virus had not protected some of the plants against infection with the severe type, all plants remaining symptomless for 30 days after inoculation were tested for the presence of such a mild strain by inoculation to pepper plants.

Since mild virus X is carried without symptoms or causes only a faint mottle in Katahdin, Sebago, and Chippewa varieties, it was not always possible to detect infected plants by inspection. Therefore, after a period of ten weeks from the date of inoculation, leaves from each haulm of each plant were inoculated to two Datura plants.

Results.

From table 4 it is evident that under the conditions of this experiment transmission by cutting knife did occur. When all varieties, with both methods of inoculation and both types of virus X are averaged together, 9 3 per cent transmission took place. When only inoculation with the severe type of virus is considered, 17 5 per cent transmission occur-

red, whereas mild type was transmitted in 1.1 per cent of the attempts. An extremely high percentage of transmission (50 per cent) was obtained when Sebago seed pieces were cut with a knife contaminated with the severe virus X These results may indicate high susceptibility of Sebago to this type of inoculation, but confirmation is needed before any definite conclusions can be drawn.

TABLE 4 —*Cutting knife transmission of mild and severe types of virus X*

	Severe X				Mild X			
	Inoculation Method A*		Inoculation Method B**		Inoculation Method A		Inoculation Method B	
	Trans. Inoc # #	Trans.	Trans Inoc # #	Trans.	Trans. Inoc # #	Trans	Trans. Inoc # #	Trans
		Per cent		Per cent		Per cent		Per cent
Katahdin	3/59	5 1	9/58	15 5	0/63	0 0	0/59	0 0
Sebago	2/50	4.0	28/56	50 0	2/51	3 9	0/63	0 0
Chippewa	5/37	13.5	3/26	11 5	1/29	3 4	0/18	0 0
Totals	10/146	6 9	40/140	28 6	3/143	2 1	0/140	0 0

*Sprouts were injured with an X-contaminated cutting knife
**Healthy seed pieces were cut with an X-contaminated cutting knife

SUMMARY

Potato virus X was found causing mosaic symptoms in potato plants of the varieties Katahdin, Sebago, and Chippewa collected from New York State potato fields.

The mosaic symptoms found on the different diseased plants varied in severity from a very mild mottle to a brilliant mottle with numerous small necrotic spots in the light-colored areas When inoculations were made to Datura, tomato, pepper, and tobacco plants variable symptoms resulted, paralleling in severity the symptoms on the original potato plants

Top necrosis did not appear on grafting to Arran Victory from each of the 78 mosaic plants found in the field, thus demonstrating the absence of virus B. The reactions are given of twelve X-free American varieties to graft infection with virus X and virus B from Green Mountain scions and from Katahdin scions infected with mild, medium or severe types of virus X.

Approximately ten per cent of the healthy seed pieces cut with a virus X-infected knife became infected with virus X. A considerably higher percentage of transmission was obtained with the severe type of virus X than with the mild type.

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SECTIONAL NOTES

COLORADO

In general the Colorado crop is good. Observations and grower reports point toward good quality of both Bliss Triumph and Red McClures The Irish Cobblers seem to be of poorer type and quality than usual. In Northern Colorado the yields are average, whereas in the San Luis Valley they are apparently better than average especially for that district. It is not unusual in the Valley to find yields of more than 300 sacks per acre. The labor shortage is still acute, being worse in some areas than it was last year. However, labor for the potato harvest is reported to be more favorable than for some of the other crops. Digging is well under way and the bulk of the crop will be harvested by the 15th of October. The quality is better than last year with all indications pointing to the fact that a higher percentage of the crop will be shipped as No. 1 grade. Unless something unforeseen develops, there will not be a great deal of trouble from rots in storage and in shipment. The car situation is tight, it is predicted that it will remain so throughout most of the shipping season

The potato Certification Service, Colorado A & M College at Fort Collins will have for distribution some of the new scab-resistant seedling No 6317 There will probably be more demand for this potato than the supply available. In order to make more seed available for next year, the requests from the certified seed growers will be taken care of first. This potato is a Katahdin-type round white and usually produces a good yield of high quality potatoes Its eating quality is also reported to be good. It is intermediate in maturity In addition to carrying scab resistance the tests in Colorado indicate that it also carries a high degree of resistance to leafroll and mild mosaic. It may carry some late blight resistance, but the Colorado tests have not been conducted under conditions favorable for severe late blight. This seedling is now being described and will be named this fall or during the coming winter. (Oct 8)—CECIL W. FRUTCHEY

INDIANA

We have had ideal fall weather for harvesting the late and main crop potatoes, the quality of which is very good and the yields average or above. The continued hot and dry weather during the month of August checked vine growth and, followed by the rains in early September, caused some second growth on Sequoias and Katahdins Our final records will not be available until the first part of December (Oct. 6).—W B. WARD

NEBRASKA

Potato harvesting in Nebraska began somewhat earlier than usual, because of a frost which killed the vines in many fields Its general effect, however, was spotted, since some fields are still growing vigorously at this writing.

Nebraska growers are quite disappointed, as a whole, with their crop of potatoes. The season began adversely, June having more rainfall than any month according to the Nebraska weather record. Following this, planting conditions were very poor, as many potatoes were planted in the mud. In July the temperature became very high, and throughout August and during the first part of September, no moisture was received in most of the late potato area The month of August was the second hottest and second driest ever recorded in the Nebraska weather bureau.

As a result of these extreme conditions, yields have been materially reduced on the dry land. The quality is also going to be reduced, because the ground was packed by the drought so that tubers simply could not grow properly. Even the growers using irrigation suffered, because the heat was so intense they could not put on the water fast enough to maintain continued growth.

The yields under the dry land conditions vary from 40 to 75 bushels per acre whereas 110 to 125 bushels are considered average. The growers using irrigation probably will have 100 bushels less than usual, and instead of many fields yielding from 350 to 400, it will probably be 250 to 300.

Our harvesting operations are now well under way, with probably one-third to one-half completed at this time. It will probably take another ten days to complete the job, providing the excellent weather conditions continue. Table stock is being sold at approximately $2.30 per cwt. f.o.b. cars for U. S. 1 grade. This is slightly above the support price at the present time Not too many sales are being made, as most of the crop is going into storage. Seed sales have been very spotted to date, and no market is established (Oct. 10) —MARX KOEHNKE

NEW JERSEY

New Jersey potato growers have finished harvesting the largest yield of potatoes ever produced in the state The average yield of the commercial acreage is estimated at 230 bushels. Several growers have reported yields above 600 bushels per acre, with four varieties producing yields of more than 700 bushels to the acre These yields were officially measured by the Monmouth County Agricultural Agent in a variety test conducted cooperatively by the Extension Service and the

Experiment Station. Excellent quality has been produced on most of the acreages and a very high percentage of U. S. 1's has been shipped. Favorable growing conditions coupled with the use of DDT, were contributing factors in these outstanding yields

With average yields increasing throughout the country at a rate considerably above the increases in consumption, the potato industry must either reduce the total acreage still further or seek much greater markets for the crop in manufactured by-products such as alcohol, starch, flour, animal feed, glucose or as processed foods These outlets will take time to develop and the logical immediate remedy for overproduction is to reduce acreage

At a recent meeting, the trustees of the New Jersey State Potato Association went on record as favoring controlled acreage with price support at a rate that would guarantee the cost of production as a long time policy for the potato industry Their spokesman, William Duryee, was authorized to report this action at the recent congressional hearing in Lancaster, Pennsylvania (Oct 17) —J C CAMPBELL.

NEW YORK

During the week of the 22nd of September, some up-state sections had three severe frosts with a temperature of 20 degrees on the 26th. Because of late planting and a dry August, the potatoes vary from small to medium, but the quality is good Although we had a general blight infection throughout the state, our growers were on the job with sprayers and dusters and kept it well under control. All growers are so busy harvesting that very few potatoes are going to market. The local demand is good Probably 70 per cent of our up-state growers are under support, and will store nearly all their potatoes, and take advantage of the winter prices. Perhaps the tax situation figures into this to a certain extent In any event with the light yield and a good demand there promises to be a ready movement of all available table stock. Our final inspection of certified acreage is being made primarily to detect infections that show on tubers Although no complete figures are available indications are that we will have a higher percentage of seed passing certification this year than during the season of 1946. (Sept. 29) —H J EVANS

OHIO

Our potato crop is late due to delayed planting caused by the exceptionally wet spring The early crop was about 75 per cent of 1946 Harvesting is practically completed with 90 per cent of the crop marketed

Most of the late crop was frosted last week and harvesting is now

under way Our yields are generally poor because of the short growing season and poor stands The total yields of both the early and late crops are expected to be 2 to 2½ million bushel below that of 1946

Our prices have remained steady with pecks selling at 50 cents and 50 pound paper at $1.50 delivered.

Weed growth in the early crop was exceptionally heavy, making it necessary to use several flame burners. Growers used the flame burners about six days before and again just previous to harvesting. This method cleared the fields of weeds and facilitated harvesting. (Oct 7) —EARL B TUSSING

PENNSYLVANIA

Heavy frosts have killed the potato vines throughout the state and harvesting is in progress. Many of the crops are large, and most growers have yields varying between 400 and 500 bushels to the acre. Late blight has been a serious problem and some rot is present, but the losses are not serious since most growers did an excellent job of spraying. The yields have not varied much in the different plots where the potatoes have been sprayed with bordeaux, the carbamates, or the fixed coppers. Blight control however, seems slightly better where bordeaux was used. (Oct 1)—O D. BURKE.

SOUTH DAKOTA

Potato harvesting is still in full swing Ten more days of good weather will find the crop under cover. Five washers are operating in the potato area and two to nine cars a day are being shipped. Most of our certified stock is going into storage. The final field inspection report shows that 5691 acres have passed certification. This consists of Bliss Triumphs, 3546, Cobblers, 1325, Red Warba, 262; Pontiacs, 249; and 309 acres of other varieties. These are located in Clark County with 3798 acres, Codington, 1282; Hamlin, 248; Kingsbury, 114; Day, 110, and other counties 139 acres. The yields are better than expected with many fields producing more than 175 bushels per acre A referendum on a proposed marketing agreement for South Dakota will be conducted in October This area will include only these counties in the Northeastern part of the state (Oct. 8)—JOHN NOONAN

WASHINGTON

Late Blight of potatoes has appeared in South Central Washington, where it is doing considerable damage to the vines of the late potato crop.

Inasmuch as growers in this area ordinarily do not spray for the late blight, they are not prepared to combat the disease on the vines.

Since the growing season is nearly over, they are interested in digging the tubers, without infecting them, and thus prevent carrying the disease to the storage bins They have been advised regarding the best methods of avoiding tuber contamination.

It has been interesting to note that over-head irrigation has been responsible for an extensive spread of late blight where this form of applying water has been used (Oct 6) —M R Harris

WYOMING

Harvesting of potatoes in Wyoming is well under way. The yield of the dry land grown potatoes is about 25 per cent less than a year ago and the yield of irrigated potatoes will also be somewhat less than that of last season. This reduction in yield is due to a less favorable growing season We had very unfavorable weather at planting time which delayed planting and a frost on the 14th of September, killed, or nearly killed, the vines in most of the fields. It is a little too early to predict the quality of our crops. The size of the tubers will be smaller this year, but the quality in general should be quite good (Oct 13) —Wm A. Riedl.

CANADA

Preliminary returns from the various provinces with regard to the seed potato acreages passing inspection in 1947 are only now being received. In Prince Edward Island, reports show that 11,900 acres of Irish Cobbler; 9,195 of Green Mountain; 5,315, Sebago; 2,617, Katahdin; and 132 acres of Sequoia passed field inspections. These figures are somewhat lower, on the whole, than those of 1946.

In the Province of Quebec, 1,593 acres of Green Mountain and 67 of Irish Cobbler passed inspection. The acreage that passed inspection in this Province is slightly higher than in 1946.

Reports from the Prairie Provinces indicate that in Manitoba the principal varieties will be. Irish Cobbler, 282 acres; Bliss Triumph, 63; Katahdin, 56; Columbia Russet, 41; Warba, 30; Early Ohio, 28; Green Mountain, 25; and Netted Gem, 24 acres. In Saskatchewan, returns so far show · Netted Gem, 43 acres; Early Ohio, 29; and Irish Cobbler, 11 acres. In Alberta, acreages passing inspection are: Netted Gem, 491; Carter's Early Favorite, 10; Warba, 9; and Canus, 6. (Oct. 8).—W. A. Fowler.

PROVINCE OF ONTARIO

The first killing frost of the season occurred on the 23rd of September. Since all tops were destroyed in practically all the potato

growing sections, digging is now progressing favorably and will probably be general about the 10th of October Skins are firming well and conditions are ideal for harvesting The quality of Ontario potatoes is considerably above average, although the total output will be below that of last year Tubers from most fields are in good condition for storage, with slight damage from blight appearing only in a very occasional crop A large percentge will grade as Canada No 1 with some total yields averaging more than 400 bushels per acre

Demands are keen, with several growers making provisions for storing The consensus of opinion is that potatoes will be good property this coming winter Several inquiries are being received for seed, both for local provincial requirements and for export to U S A

The prices vary according to the locality, with Toronto quotations lowest across the Province at $1 60 to $1 75 per 75 pound bag, wholesale to retail, for Conada No 1 grade Our growers are asking $1 75 to $2.25, according to variety and locality, for Foundation A grade seed at the farm or local shipping point (Oct 8).

ANNUAL MEETING

POTATO ASSOCIATION OF AMERICA

HEADQUARTERS AT PALMER HOUSE, CHICAGO, ILL.

DECEMBER 28 - 31

Secretary — Reiner Bonde

The following committees have been appointed

Registration—Harry A. Reiley
Honorary Members—Frank E. Garrett
Certification Committee — Henry M. Darling
Potato Research—E V. Hardenburg, *Chairman*
Potato Breeding—G. H. Rieman, *Chairman*
Harvest, Transportation & Storage—J M Lutz, *Chairman*
Fertilizer & Culture — John Bushnell, *Chairman*
Virus & Bacterial Diseases—Jas H. Jensen, *Chairman*
Insect Problems—Roscoe E Hill, *Chairman*

The tentative program follows

Sunday, December 28

9.00 A M, Potato Association—Private Dining Room 9
1.30 P M, Potato Association—Private Dining Room 9

Monday, December 29

9.00 A M., Potato Association—Private Dining Room 9
1.30 P M., Potato Association—Private Dining Room 9
7.30 P M, Potato Association—Private Dining Room 18

Tuesday, December 30

*9.00 A M, Joint session with American Phytopathological Society—Private Dining Room 1 O. D. Burke, *Chairman*
1.30 P M., Potato Association—Private Dining Room 9

Wednesday, December 31

9 00 A M., Joint session with American Society for Horticultural Science—Private Dining Room 17.

*The joint session with the American Phytopathological Society will be held at the Stevens Hotel All others at the Palmer House

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of American Potato Journal, published monthly at New Brunswick, New Jersey, for Sept 23, 1947

State of New Jersey
County of Middlesex ss

Before me, a Notary Public in and for the state and county aforesaid, personally appeared W. H. Martin, who having been duly sworn according to the law, deposes and says that he is the Editor of the American Potato Journal and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc, of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411 Postal Laws and Regulations, printed on the reverse of this form, to-wit

1 That the names and addresses of the publisher, editor, managing editor, and business managers, are:

Publisher—Potato Association of America, New Brunswick, New Jersey.
Editor—W. H Martin, New Brunswick, New Jersey
Business Manager—W H. Martin, New Brunswick, New Jersey

2 That the owner is (if owned by a corporation its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock If not owned by a corporation, the names and addresses of the individual owners must be given If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given).

Potato Association of America, New Brunswick, New Jersey

3 That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state) None

4 That the two paragraphs next above, giving the names of the owners stockholders and security holders, if any contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholders or security holders appear upon the books of the company as a trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given, also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities, in a capacity other than that of a *bona fide* owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him

5 That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is—(This information is required from daily publications only).

W. H MARTIN, Editor

Sworn to and subscribed before me this 23d day of September, 1947
R. E Long, Notary Public, Middlesex County, New Jersey.
(My Commission Expires January 31, 1949)
Form 3526—Ed. 1924.

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INDUSTRIAL UTILIZATION OF CULL AND SURPLUS POTATOES

R. H. TREADWAY

Eastern Regional Research Laboratory, Philadelphia, Pa.*

Efficient utilization of cull and surplus potatoes presents many difficulties. Culls, which constitute from 5 to 15 per cent of the annual crop, create a utilization problem each year, and this is magnified by the occasional surplus crop The problem of surplus potatoes was made unusually conspicuous by the record crop in 1946. Since the consumption of potatoes as a food does not vary appreciably with fluctuations in their availability and price, outlets for surplus potatoes must be sought through industrial utilization

The yield of potatoes increased from an average of 126 bushels per acre in the 1935-1944 period to 155 in 1945 and an all-time record of 184 in 1946. The 1946 crop was grown on the smallest acreage planted since 1892, and the 1947 crop was planted on a still smaller acreage (Table 1)

Several factors are responsible for the huge potato surpluses of 1943 and 1946. During the war, it was necessary to produce an enormous amount of food, requiring maximum agricultural efficiency. There was a switch from low-yielding to high-yielding areas. Chemical fertilizers were applied more commonly and in greater amounts than ever before Improved insecticides were introduced; widespread use of DDT for the first time is generally believed to have been instrumental in developing the record potato crop in 1946. Finally, the ideal weather of the 1946 season played an important rôle.

TABLE 1 *Acreage, yield, and production of potatoes in the United States from* 1935-1947*

Year	Acreage Harvested	Yield Acre	Production
	1000 acres	Bushels	1000 Bushels
1935	3,469	109 2	378,895
1936	2,960	109 4	323,955
1937	3,055	123 2	376,448
1938	2,870	124 0	355,848
1939	2,813	121 7	342,372
1940	2,832	133 1	376,920
1941	2,693	132 1	355,697
1942	2,671	138 1	368,899
1943	3,239	141 7	458,887
1944	2,786	137 6	383,424
1945	2,700	155 1	418,765
1946	2 580	184 5	475,969
1947	2,190	168 1	379,886

*Source U S Department of Agriculture, Bureau of Agricultural Economics

Industrial utilization of surplus potatoes is difficult because of the uncertainty of supply Moreover potatoes are perishable, and must be processed within a limited time after harvesting Since potatoes contain about 80 per cent water, transportation is expensive, and handling costs are high Other principal crops which sometimes are harvested in surplus, for example, corn, wheat, cotton, and tobacco, can be put into storage at ordinary temperature without processing, and thus can be saved to offset a lower yield of a following year But potatoes that are not kept in cold storage or preserved by some other treatment will sprout, which destroys not only their appearance as a food product but also much of their carbohydrate constituents

Stated broadly, the problem of utilizing cull and surplus potatoes can be solved or alleviated by (a) developing new non-food outlets, preferably profitable, for fresh potatoes, (b) by improved methods for converting potatoes into stable forms to permit storage for utilization later as food, feed or industrial raw materials, and (c) developing efficient and economical methods of storing fresh potatoes Because of the many disadvantages involved in dumping potatoes, probably it is preferable in some instances to divert surplus potatoes into industrial channels without profit or even at a slight monetary loss

*One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, United States Department of Agriculture.

Current Outlets for Cull and Surplus Potatoes

Several well-established outlets now exist for diversion of cull and surplus potatoes from the regular table stock market. Potatoes are used in food-processing industries, livestock feeding, starch production, alcohol production, and in smaller miscellaneous outlets. Beginning in 1937 and continuing during surplus crop years, the U. S. Department of Agriculture has operated diversion programs under which industrial users of surplus potatoes obtained them at low cost.

Starch Production.—Utilization of potatoes for starch production is perhaps the oldest industrial use. Early in the history of the potato starch industry, potatoes of high starch content were grown specifically for this purpose. Much of the total starch produced in the United States during the first half of the nineteenth century was made from potatoes. Late in the last century there were about 150 potato starch factories in Maine, New Hampshire, Vermont, Ohio, Michigan, Wisconsin, and Minnesota. After about 1880, the production of potato starch decreased because of the rise of the cornstarch industry and also because the improvement in transportation made it profitable to grow and move more table stock potatoes to distant markets.

Cornstarch was first produced in 1842 and rapidly became the principal starch since it was soon apparent that potato starch could not compete in price. Potato starch then became a specialty starch and retained this position regardless of its higher price. Aroostook County, Maine, became the center of the potato starch industry, the starch factories forming an outlet for cull and surplus potatoes. About 20 factories now operate in Maine, with a total capacity of approximately 50 million pounds a year. Four starch factories established in Idaho in 1941 can produce about 30 million pounds of starch annually. More recently still, a cooperative established a potato starch factory in Lynden, Washington, where the starch is converted to glucose. If all the starch factories in the country operated at capacity for a 200-day season, 10 to 15 million bushels (2½ to 4 per cent of the total production) of potatoes would be consumed. Table 2 shows the amounts of potatoes consumed in starch manufacture and the quantities of starch produced annually from 1930 to 1945.

The daily capacity of existing starch plants ranges from 5 to approximately 25 tons. A starch factory which produces 5 tons of starch per day for a 200-day operating season needs approximately 300,000 bushels of potatoes. It should preferably be located in a region where potatoes can be stored and where an abundant supply of good water is available. Because the raw material cannot be kept in ordinary stor-

TABLE 2 *Quantities of potatoes used and potato starch produced in the United States from* 1930 *to* 1945*

Crop	Potatoes Used for Starch Manufacture 1000 Bushels	Computed Quantity of Starch Produced (1000 pounds) (On basis of 7.27 Pounds Starch per Bushel)
1930	1,662	12,088
1931	2,554	18,574
1932	1,343	9,768
1933	1,399	10,174
1934	5,319	38,684
1935	1,475	10,728
1936	1,834	13,338
1937	3,680	26,764
1938	2,932	21,324
1939	2,699	19,630
1940	8,030	58,400
1941	4,892	35,578
1942	3,308	24,078
1943	10,050	72,112
1944	4,005	29,124
1945	5,682	41,320

*Source. Potato Division, Fruit and Vegetable Branch, Production and Marketing Administration, United States Department of Agriculture, Washington, D C

age during the summer, potato starch factories seldom operate more than 8 months of the year, from about 1st of October to the 1st of June. In addition to the short operating season and uncertain supply of raw material, the problem of disposing of starch-factory wastes, which has become increasingly important in recent years because of the movement to eliminate stream pollution, has been a drawback The fact that potatoes for industrial processing cannot be economically transported great distances has favored the plan of locating small factories throughout a high production area, for example, Aroostook County, Maine, instead of the establishment of a few, centrally located, larger plants.

The Green Mountain variety of potato formerly constituted a high percentage of the total supply grown, but in recent years there has been a trend in Maine toward the production of Katahdin, Sebago, Chippewa, and other varieties which contain less starch but are more disease-resistant This switch to potatoes of lower starch content has discouraged expansion of the potato starch industry in Maine

In processing potatoes for starch recovery, the methods in general consist of grinding the washed tubers to a pulp, screening the fibrous material from an aqueous starch suspension, removing impurities from

the starch, and drying. A starch factory which extracts 85 per cent of the available starch in potatoes is considered to be relatively efficient Thus 100 pounds of potatoes containing 13 per cent starch, about the average for the varieties now grown, will yield about 11 pounds of dry starch or approximately 13 pounds of starch containing 17 per cent moisture, the average for commercial potato starch Potato starch currently brings the factory 8 cents per pound which accounts for a gross return of $1 04 from 100 pounds of potatoes No reliable manufacturing cost data are available, but total costs are estimated at 1 to 2 cents per pound of starch. It is evident that, after manufacturing costs are taken into consideration, the price which may be paid for the raw material is much less than the selling price of table stock potatoes

Potato starch is used principally in the textile mills of New England and the southern states for sizing cotton, spun rayon, and worsted warps It is also used to a less extent as such and in the modified form of dextrin in adhesives, in paper sizing, in the baking industry, in fine laundering, and as a thickening agent for various applications.

Prior to World War II, potato starch was regularly imported from the Netherlands to supplement a deficient supply of high-grade domestic starch The construction of modern plants in Maine and Idaho in the period 1938-1941 and the improvement in manufacturing operations resulted in a domestic supply of high-quality starch which satisfied the most essential needs during the war and postwar period The potato starch industry appears to be firmly established, and a modest expansion could probably take place without saturating the market.

Food Processing—The *per capita* consumption of potatoes has markedly declined during the past 35 years or so (from 197 pounds in 1910 to 126 pounds in 1946). This trend has been attributed to various factors, such as (a) increasing competition of other vegetables, both fresh and frozen, which are available throughout the year in attractive forms; (b) gradual rise in the economic level of the average American, with the accompanying ability to purchase a greater variety of the more expensive vegetables; and (c) the erroneous conception that potatoes are more fattening than other carbohydrate foods The decreased consumption of potatoes might be due also to the fact that the population shift from rural districts to urban centers has resulted in a demand for foods which involve less preparation than is entailed in peeling and cooking potatoes The consumption, therefore, might rise if potatoes were processed into forms which are either ready to eat or readily prepared for the table In any event, in recent years there has been an increase in the amount of potatoes going into pro-

cessed foods, and this trend may in part offset the lower consumption of potatoes in the ordinary form.

Among food products made from potatoes, chips occupy a prominent place Potato chips have been produced for many years, but only in the last 10 to 15 years has the industry grown to large proportions In 1946, 15 4 million bushels of potatoes were processed into 243 6 million pounds of chips, an average yield of 25 8 pounds of chips per 100 pounds of raw potatoes (5). The average *per capita* consumption in 1946 was 1 8 pounds of potato chips. The shortages of vegetable fats and processing machinery during the war retarded expansion of the potato-chip industry, but with the current improvement in these supplies further expansion is anticipated.

In producing chips, clean, peeled, potatoes are sliced thin, washed and drained to remove loose starch granules, and then fried in oil. Certain varieties of potatoes are better for making chips than others, but an important factor, regardless of variety, is the so-called reducing sugar content of the potatoes (2) Chips produced from potatoes containing an appreciable amount of reducing sugars are dark and relatively unpalatable. Freshly dug potatoes are generally low in sugar content, but they accumulate sugars in cold storage If such potatoes are kept at approximately 60° to 70° F. for several weeks, however, the sugar content is reduced. Inasmuch as chips sell for a good price and potatoes of a certain type must be used, potatoes intended for chips bring a premium above that of ordinary table stock

Potato flour seems to have been the first processed potato product to reach quantity production. It was produced in the United States during the first World War as a substitute for wheat flour In producing flour, the potatoes are peeled, generally cooked, dried, and then ground to a powder or meal Potato flour is used in admixture with wheat flour in the baking industry, as a "breading" agent for meats, poultry, and vegetables, as a thickening agent in soups and sauces, and as an extender in sausages, meat loaf and scrambled eggs About 20 million pounds of the flour are produced annually, requiring about 1¾ million bushels of potatoes. Most of the potato flour is produced in four factories in Idaho Other plants are located in Michigan and Minnesota Although potato flour is evidently well established in its limited market, the growth of the industry has been rather slow

A recent development in the merchandising of potato flour consists of a blend of the flour with dehydrated onions and seasoning to comprise a potato pancake mixture

In addition to potato chips and flour the food processing industry also produces dehydrated potatoes, canned potatoes, potato soup, and

potato salad, fast-frozen preparations, and peeled fresh potatoes. During World War II, a considerable tonnage of potatoes was dehydrated, chiefly for shipment to the armed forces. The potatoes were diced, riced, shredded, or granulated and then dehydrated in either the cooked or blanched, uncooked form. At the end of the war, most of the manufacturers stopped their operations, but a few have continued in the field and now turn out a dehydrated product which, after proper reconstitution, is difficult to distinguish from freshly cooked mashed potatoes

Potatoes have been canned to some extent in the last few years. Generally, whole, peeled potatoes of small size are used for this purpose French-fried, sliced, diced, and julienne potatoes, potato salad, and potato soup are also canned

Frozen French-fried potatoes have been placed on the market recently. It is also reported that raw sliced potatoes are being fast-frozen.

Potato-peeling plants have been established in several large Eastern cities. This industry delivers peeled ready-to-cook potatoes to restaurants, hotels, and other large consumers

Livestock Feeding For many years, cull potatoes have been fed to livestock on the farms where the potatoes were grown. This is probably the most economical utilization of cull potatoes, since no transportation or processing is required As a rule, the potatoes are cooked if they are to be fed to hogs, but raw potatoes, usually chopped or ground, are fed to sheep, dairy cattle, and horses. Perhaps 5 per cent of the annual crop of potatoes is disposed of in this way.

If it is not practicable to store cull and surplus potatoes or use them immediately in the fresh form as feed, perhaps the next most feasible thing is to convert them into silage In the form of silage, potatoes may be stored for at least one year Potato silage has about the same palatability as corn silage, and it is approximately equal to corn silage in feed value on the dry weight basis A number of methods have been followed (6) The potatoes may be either raw or cooked They may also be mixed with grass, clover hay, alfalfa, or ground corn before being ensiled The ensiling process may be conducted either in a tower or a trench silo The trench silo method is apparently the most economical for large-scale operations. Potatoes are loaded into trucks, covered, steamed while on the trucks, and then transported to previously prepared trenches. After a trench has been filled, it is covered with soil or agricultural wastes, such as pea vines During the summer of 1946, following small-scale experiments in

North Carolina (4) and Colorado (1) which demonstrated the feasibility of the method, about 300,000 bushels of potatoes were ensiled in northern California (3) by this process.

Dehydrated potatoes have been fed successfully to livestock This material is comparable, if not quite equal, to corn in feed value In several of the western states during hot, dry seasons, potatoes have been sliced or crushed and subsequently dried in the open air Perhaps one of the more economical methods for drying potatoes is that practiced in 1946 on the concrete runways of airfields in the desert region of California. Potatoes were crushed with large mechanical equipment and left to dry in the hot, dry air An alternative procedure of sun drying practiced in 1946 in Kern County, California, was to spread whole potatoes on a bed of straw and let them dry for three months Another economical method of air-drying was used in North Dakota during the winter and spring of 1946-1947 Whole potatoes were spread on the ground to freeze and subsequently dehydrate. If it is not practicable to use air-drying because of climatic conditions, as much water as possible can be removed by pressing and then the press cake can be thermally dried A plant was established in Grand Forks, North Dakota, recently to mechanically dewater and thermally dry cull potatoes for feed During periods of potato surplus and grain shortage, potatoes have been dehydrated in cider mills and sugar beet plants for production of feedstuff and raw material for alcoholic fermentation Experience has shown, however, that the mechanical and thermal dehydration of potatoes for production of feed and fermentation raw material is uneconomical unless the potatoes are obtained at a low cost and the product is sold at a relatively high price By special arrangement with the United States Department of Agriculture, one plant is now dehydrating potatoes at the rate of 60 carloads (900 tons) per week If conditions continue to be favorable for these operations, the cost of this plant may be amortized in one or two seasons.

It has been estimated by the Chemical Engineering and Development Division of this Laboratory that the cost of drying potatoes by an economical method which also reduces explosive hazards to a minimum is about $23 00 a ton of product containing 12 per cent moisture In their improved process the potatoes are hammer-milled, mixed with dried product to reduce the moisture content to 40-45 per cent, and dried in a rotary steam-tube drier The estimate for this process includes all costs except that of the potatoes and the selling cost of the product If it is assumed that dehydrated potatoes have 0 9 the feed

value of corn and that corn is worth $1 00 a bushel, then, in order to compete, raw potatoes would have to be delivered at the dehydration plant at about $1.40 per ton, if the processor is allowed a return of 10 per cent on his investment With corn at $2.00 a bushel, potatoes would be worth about $8 70 a ton In several industrial applications, for example livestock feeding, starch production, alcoholic and certain other fermentations, and glucose sirup and dextrose sugar production, potatoes must compete with corn Table 3 shows that dehydrated potatoes compare closely with corn in composition, with the exception that corn contains much more fat

TABLE 3 *Typical analyses of potatoes and corn*

	Potatoes	Dehydrated Potatoes*	Corn
Moisture, per cent	78 9	10 0	10 8
Carbohydrate (mainly starch), (Per cent)	17 4	74 4	73 4
Protein, per cent	2 1	9 0	10 0
Fat, per cent	0 1	0 4	4 3

*Values obtained by assuming dehydrated potatoes contain 10 per cent moisture and computed from analysis of fresh potato without regard to the loss of protein during processing

Corn dries out naturally on the cob to about 10 per cent moisture content, whereas potatoes must be transported to a processing plant and dehydrated at considerable expense to reduce the moisture content to a comparable percentage.

Alcohol Production. In Germany and in certain other European countries, potatoes have been used for many years as raw material for alcoholic fermentation Varieties of potatoes having high-starch content were grown for this purpose, and the industry was controlled by the government and closely integrated with the potato industry.

A pilot plant for the conversion of cull potatoes into alcohol was established by the state of Idaho at Idaho Falls about ten years ago After several years of operation, the plant was sold to a private company, which continued to operate for a while Somewhat larger distilleries (with a capacity of about 5000 gallons of 190-proof alcohol per day each) were established at Newmarket, New Hampshire, in 1944 and at Caribou, Maine, in 1946 for the production of alcohol from potatoes In this process, the potatoes are washed, cooked, and then cooled to the temperature at which malt converts the starch to sugar The sugars are fermented to alcohol by yeast, and finally the alcohol is distilled from the mash

One hundred pounds of potatoes will produce about one gallon of 190-proof alcohol. If industrial alcohol is produced, the distiller

must obtain potatoes at a relatively low price in order to operate profitably If the distillery produces alcoholic beverages, a greater financial return is realized from the alcohol The future for potato alcohol in this country seems to depend largely on whether potato liquors of unique flavor can be popularized Since the Federal tax represents the main part of the cost of alcoholic beverages, the higher cost of potatoes as a raw material would be relatively unimportant Consumer acceptance of blended whiskey containing potato alcohol, however, has not been particularly encouraging

In addition to the three distilleries established specifically for fermentation of potatoes, many larger distilleries used dehydrated potatoes during 1943 and both fresh and dehydrated potatoes in 1946 While grain was scarce, distilleries were glad to receive potatoes as raw material, which was made available to them principally through the diversion program With grain again available, however, there has been a tendency to return to corn Several distilleries object to the use of potatoes on account of the higher material cost and the higher handling expense caused by the bulkiness of potatoes However, potatoes may again be widely used for fermentation if corn prices remain unusually high and potato surpluses occur A large proportion of the potato alcohol produced in 1947 has gone into industrial uses, little now being used for beverage purposes Some potatoes recently have been fermented to butyl alcohol instead of ethyl alcohol

Glucose Sirup and Dextrose Sugar. In Germany, The Netherlands, and certain other European countries where potatoes are the common source of starch, the production of potato sirup and dextrose sugar is a long-established industry. During World War II, supplies of cane and beet sugars in the United States became entirely inadequate Sales of corn sugar increased from 459 million pounds in 1939 to 771 million pounds in 1942 (7) Sales of corn sirup increased from 1,142,000,000 pounds to 2,025,000,000 pounds, or 77 3 per cent during the same period (7) Even at this high rate of production, the available supply was far short of the demand, and sources of starch other than corn were sought to supplement the deficient supply of cornstarch for sirup

In 1942, a plant was established at Lynden, Washington, by the Northwest Chemurgy Cooperative to produce sirup from potato starch The process used by this organization in producing potato sirup has not been made public In converting starch to sirup hydrochloric or sulfuric acid in low concentration is ordinarily used as catalyst, the reaction being carried out in about 10 to 15 minutes in an autoclave.

The resulting liquor, containing dextrins, maltose, and dextrose, is then neutralized, filtered, decolorized, and evaporated to sirup under reduced pressure.

Corn sirup generally sells for a fraction of a cent above the cost of the starch and at less than the cost of potato starch. It appears that in the absence of quality advantages potato sirup will have some difficulty in competing with corn sirup under normal conditions.

A few sugar beet factories which dehydrated surplus potatoes in recent years, during the off-season in the beet industry, converted by-product starch into sirup, but the considerable outlay of additional equipment required for outfitting a sugar beet factory to produce glucose sirup has discouraged further development along this line.

Disposition of Recent Potato Crops

The total potato production in 1946 was 475 million bushels, about 100 million bushels in excess of our normal requirements. Table 4 shows the disposition of this surplus.

TABLE 4. *Disposition of surplus potatoes from the 1946 crop. Stocks removed from the market by the government and diverted into various outlets**

Outlet	Million Bushels
Alcohol production	29.2
Unharvested, deteriorated; lost in field storage	26.5
Livestock feed	18.3
Exported	11.3
Starch (mainly), flour, glucose	9.5
School lunches, direct relief to public institutions	3.2
Disposition undetermined (pending receipt of final reports)	0.5
Total	98.5

*Supplied through the courtesy of A. E. Mercker, Acting Chief, Potato Division, Fruit and Vegetable Branch, Production and Marketing Administration, United States Department of Agriculture, Washington, D. C.

Table 4 does not include figures on most of the potatoes processed in Idaho for starch, alcohol, feed, and other purposes; these were mainly culls purchased by processors directly from growers and shippers. In addition, an estimated five million bushels of potatoes were purchased outside of the Government program by distillers during the spring and summer of 1946.

Considerable criticism has been caused by failure to export more

surplus potatoes during the world food shortage The greater weight and bulk of potatoes, as compared with grain of equivalent food value, and their perishability have discouraged exportation of fresh potatoes on a larger scale. On the other hand, foreign relief agencies have in general refrained from contracting for dehydrated potatoes because of their high cost.

Present Investigations

Investigations on potatoes are in progress at the Eastern Regional Research Laboratory along the following lines (a) Conversion of potatoes into stable forms, for example, a dehydrated form or a concentrated hydrolyzate, which may be stored Estimates based on batch operations at atmospheric pressure indicate that it will cost about $38 80 per ton of dry solids to prepare feed-grade potato "molasses" (acid-converted, neutralized, and concentrated), as compared with $26 20 per ton of dry solids for dehydrated potatoes. It is not known what the cost would be with a continuous process at higher temperature and pressure. (b) Improvement of the economic position of potato starch by technological advances in processing and by extension of uses, thereby encouraging greater diversion of potatoes into the starch industry Studies of the fundamental physical properties of potato starch are being made which it is hoped will suggest new applications in which potato starch is superior to others (c) Development of new industrial processes that will utilize the potato, for example, fermentation of saccharified potatoes to lactic acid, and possibly butylene glycol, acetone, and butanol. In such processes the mineral and protein contents of the potato might give it an advantage over some other carbohydrate bases, such as, corn starch, to which fermentation nutrients must be added (d) Improved methods for storing fresh potatoes for later use as food or industrial raw material

The general objective of the research in the National Potato Breeding Program, carried out by the Bureau of Plant Industry, Soils, and Agricultural Engineering in cooperation with about 25 State Agricultural Experiment Stations, is to develop new potato varieties that will combine as many of several desirable characteristics as possible, including high yield, disease resistance, good edible quality, and pleasing appearance of skin and flesh Earlier experiments by the Department on imported varieties of European potatoes of high starch content were disappointing in that yields were poor and edible quality inferior. Further work in this field may eventually develop a potato variety of high starch content which will not only be better for table

use but also provide a more economical raw material for industrial utilization.

Outlook for Utilization of Potato Surpluses

In all probability no single industrial use will solve the problem of potato surpluses Instead potatoes may continue to be used in several processes but more efficiently than in the past. There is the possibility, however, that an industrial process will be found in which the minor constitutents of the potato will give it some advantage over corn, wheat, and other high starch crops If potatoes are expected to compete with corn on an equivalent starch basis, however, the potato industry and scientific workers must unite to make industrial processing of potatoes more profitable The potato program under the Research and Marketing Act of 1946 may be expected to aid in solving problems of production, marketing, consumption, and utilization

Closer grading of potatoes and state marketing agreements may result in better potatoes for the table stock market, an increase in consumption, and the reward of a higher selling price Closer grading to improve quality will also produce a larger supply of culls for industrial use It seems then that the potato industry might be able to enter operations in the processing field, with a higher price from better quality table stock potatoes helping to offset unfavorable economics If no good use is made of the substandard potatoes, the alternative is dumping, which entails expense, is hazardous from the standpoint of spreading potato diseases, and is abhorrent to the American public, particularly because of starvation conditions in many parts of the world

The widespread adoption of improved methods of storing potatoes to make them suitable for utilization over a longer period of time should be helpful in dealing with the surplus potato problem More general practice of ensiling and air-drying potatoes will provide a way of preserving them for later use as feed without expensive processing Establishment of potato starch and alcohol factories in regions of high potato production should be encouraged in order to provide outlets for the inevitable supply of cull potatoes and for the occasional surplus crops In addition, the research now in progress on improved varieties, superior processing methods, and new outlets and applications should improve the position of the potato as an industrial raw material

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THE PROTECTION OF THE PROPERTY OF THE POTATO BREEDER IN THE NETHERLANDS

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"What the inventor is to industry
that the plant breeder is to agriculture"

The above motto expresses the thought that the originators of new varieties render a service to society comparable to that done by inventors The work of the plant breeder is on a par with that of the technical innovator in making the life of his fellow men more abundant.

The law in all civilized countries sees to it that the inventor derives a just profit from his labor, patent rights protect his work The more the invention is applied, the larger the reward of the inventor. Authors and artists are also protected similarly by a copyright

These legal measures satisfy a sense of justice and at the same time stimulate inventive activity and cause social progress What labor and ingenuity they have encouraged! They have vigorously furthered the development of agricultural implements, motors, electric lamps, radios and of thousand other tools of modern civilization They have enabled the creation of a great number of works of art If patents and copyrights were abolished many gifted people would have to earn their living in another way, doing less important things

Until recently a plant breeder who sold a handful of grain or a few tubers lost his ownership of the variety Any one could increase and sell the stock without obligation to its originator In some countries a regulation for the protection of the rights of the breeder have come into being Visitors from abroad to our institute are always highly interested in the way the property of the plant breeder is safeguarded in the Netherlands In this article I shall try to sketch the essential features of the protective measures

In a commentary on the contents of the twenty-second "Descriptive List of Varieties of Field Crops 1947" the following statement is made concerning the supplying of seed and planting material in the Netherlands

"Gradually the conviction has grown in the Netherlands that the breeder of new varieties performs a very important social function and his work has the right to be protected and supported by the Government At the same time the opinion has gained ground that it is a matter of general interest that only first-rate seeds and planting material from the best varieties shall be confided to the soil"

These principles have been laid down and further worked out in the Plant Breeder's Decree put into operation in 1941 (Decree defining the legal position of the breeder and regulating the bringing into circulation seeds and planting material)

So far as field crops are concerned we may add the following

(1) A new variety, whether produced by a foreign or a Dutch breeder, can be entered in the "Dutch Central Register of Varieties" which has the effect that the breeder (or the owner of his rights) obtains the "legal rights of the breeder" including, among other things, the right to compensation for certified seeds and seed potatoes grown by others.

(2) In the "Dutch Descriptive List of Varieties" are mentioned the varieties of special value to Dutch agriculture.

(3) Only the varieties included in the "Dutch Descriptive List of Varieties" are controlled by the General Netherlands Inspection Service for Seeds of Field Crops and for Seed Potatoes (N A K) at Wageningen

(4) Only certified seeds and planting material may be brought into circulation in the Netherlands; or, be exported.

In this way the best guarantee is given to the purchaser of Dutch seeds and planting material that only first-class merchandise is brought into circulation This regulation affords at the same time an opportunity to give the breeder an adequate reward for his difficult and painstaking labor

Two points may be of special interest in connection with the above general outline How are the funds formed from which the breeder is paid? According to what scale are the payments calculated?

The breeder's compensation funds are managed by the N A K They are obtained through a levy on seed produced from crops raised by growers who do not act on behalf of the breeder and who did not develop the variety (once, twice or more often grown seed). The

same holds for seed potatoes It is logical that the contributions should be levied on the production by others of the breeders' varieties

For potatoes the levy is f 0 03 (slightly more than one dollar f 1 — = 0.38) per kg certified seed potatoes, but the compensations to the breeder of potato varieties are determined per hectar of certified seed potatoes according to the following system

Number of Years That a Potato Variety Is on the Market	For the First 500 Hectares*	For the Second 500 Hectares	For the Next 2000 Hectares	For the Further Area of Certified Potatoes
	Per Hectare	Per Hectare	Per Hectare	Per Hectare
1-15 Years	f 12 50	f 10 —	f 5 00	f 1 —
16-25 Years	f 10 —	f 5 —	f 2 50	f 1 —
26 Years and More	f 5 —	f 2 50	f 1 —	f 1 —

The minimum compensation is f 500 — (about $190) during the first five years If a potato variety originates through a bud mutation this minimum is f 125 —, except for the variety Roode Eersteling for which the minimum is f 250 —

In case of bud mutations the compensation is one-fourth of the above-mentioned rate; for the variety Roode Eertseling the compensation is, however, one-half of the normal rate.

Varieties that have lost their importance and figure in the List of Varieties under the heading O (variety of minor importance, no longer described) are considered to belong to the class of 26 years or older

For the 1941 harvests the compensations to potato-breeders or their assigns amounted to f 46758 51; for the harvest 1944 to f 73,952. As an example we specify for a few potato varieties the compensation paid in 1941

Alpha	f 5966 95	Noordeling	f 2691 —
Bevelander	f 6147 50	Record	f 1655 87
Furore	f 6815 30	Triumph	f 4649 —
Gloria	f 1118 75	Ultimus	f 4922 75

The breeders of 8 new potato varieties received in 1941 the minimum amount of f 500 —

In case a private person owns the breeder's right of a variety (which often happens in the Netherlands), the allocation is simple. but if an employee of a cooperative or of a government institute has bred a variety, it will be necessary to stipulate by contract the sum to which he is entitled. In various cases the employees have received 10 to 15 per cent of the compensation.

As was shown in the beginning of this article the ascertaining of

*Hectare=2 471 acres

the identity of new varieties for the Central Register, the testing of the cultural value for the List of Varieties, the crop inspection and the marketing of seeds and propagation material now have been co-ordinated in the Netherlands; the basis is the Plant Breeder's Decree, *viz.* the recognition of his proprietary rights The protection of the breeder's ownership and the allocation of bonuses have had a favorable influence on the improvement of crop plants More efficiently organized establishments, additional personnel, technical collaborators, better equipment, increase of the number of plant breeders have resulted.

The Plant Breeder's Decree, put in force in the Netherlands, relates also to varieties of foreign breeders, who are placed on an equal footing, provided in the country involved reciprocal arrangements exist In every country where an inspection service for field crops exists, it is possible to find a formula to reward the breeder (Wageningen, August, 1947)

A PROGRESS REPORT ON STUDIES OF THE EFFECTS OF VARYING THE PROPORTION OF LIME IN BORDEAUX MIXTURE FOR POTATO SPRAYING[1]

L. C. CALLBECK[2]

Since 1943 some investigational work has been conducted at the Dominion Laboratory of Plant Pathology at Charlottetown with bluestone-lime ratios in Bordeaux mixture The results of these studies have proved so interesting that it is considered advisable to present them, in a short paper, at this time, and, although the studies have not been conducted on a scale sufficiently large for statistical analyses, the general trend in the control of late blight of potato is worth noting

The use of low-lime Bordeaux mixtures was introduced as a necessity in 1943 when supplies of hydrated lime in Prince Edward Island were considered inadequate to maintain an intensive spray program if a severe epiphytotic developed during the season The performance of three Bordeaux mixtures having the formulae 4-4-40, 4-3-40, and 4-2-40, together with three commercial fungicides, was studied. The variety Green Mountain was chosen for these experiments because of its susceptibility to attack by the late blight fungus, *Phytophthora infestans* (Mont) de Bary

RESULTS FOR 1943

The first applications of the several fungicides were made on the 20th of July and the last on the 10th of September, the total number

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[2]Assistant Plant Pathologist Dominion Laboratory of Plant Pathology, Charlottetown, Prince Edward Island, Canada

being seven The sprays were applied with a tractor-sprayer combination, power take-off type, having four nozzles per row, and maintaining a delivery pressure of 275 pounds Complete coverage of the foliage was reasonably assured by driving the sprayer both up and down the rows each day the applications were made This technique is employed annually.

Some interesting data on foliage and tuber infection were collected and the results indicated the desirability of making more intensive studies. The data on foliage infection were obtained by making counts in four randomized blocks of twenty-five plants each, in each of the plots, and at four different dates The results of these readings are shown in table 1, in which it is indicated that the 4-2-40 Bordeaux mixture gave the best control of the late blight disease

TABLE 1 —*Late blight infected leaflets,* 1943

Treatment	Percentage of Leaflets Infected				Increase for Period
	Aug 18	Aug 25	Sept 2	Sept 9	
4-2-40	0 2	0 6	1 5	3 0	2 8
4-3-40	0 4	1 3	2 2	3 9	3 5
4-4-40	0 2	0 9	1 5	3 9	3 7
Cop Hydro 40	0 1	0 5	1 3	3 5	3 4
Coppesan	0 4	0 6	1 1	3 7	3 3
Perenox	0 1	1 3	3 5	4 7	4.6
Check[1]	17 0	60 0	95 0	100 0	83 0

[1]Percentage infection estimated.

RESULTS FOR 1944

Because the 4-2-40 Bordeaux mixture, in the 1943 test, had shown some superiority in late blight control compared with Bordeaux mixtures having a higher lime content, it was decided to reduce further the lime by one unit and a 4-1-40 Bordeaux mixture was included in the 1944 trials This mixture, judged on the basis of tuber rot in the crops, gave the most effective control of late blight, as shown in table 4 Late blight became very severe during the latter part of the growing season and the check plots showed a loss of 23 8 per cent of the total yield because of late blight rot Plots sprayed with 4-1-40 Bordeaux mixture showed a loss of only 0 5 per cent.

RESULTS FOR 1945

In 1945, the plan of plot arrangement was changed in a way calculated to place all fungicides on an equitable basis and under a more rigorous test Unsprayed plots were alternated with the treated plots in

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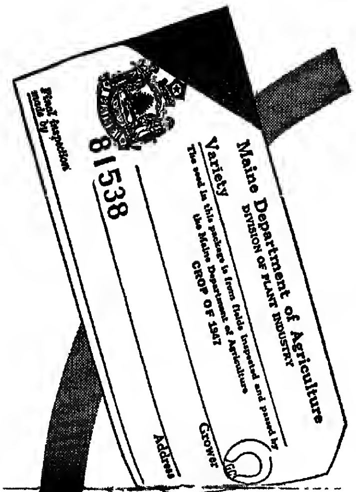

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each block of replicates so that the plants in each sprayed plot were given equal opportunity for infection This plot arrangement was also employed in the 1946 experiment

Late blight did not make its appearance until late in the growing season of 1945 and very few lesions were found in the testing area before the middle of September At the end of the month a reading of the degree of foliage infection was made On the 1st of October the temperature dropped to 25° F at grass level, making further accurate counts impossible The figures obtained at this examination are shown in table 2

TABLE 2—*Comparative numbers of late blight lesions, September 27, 1945*

Treatment	Number of Lesions per Ten Plants	Deviation from Mean	
		Minus	Plus
4-1-40	0 0	24 0	—
4-2-40	2 0	22 0	—
4-3-40	2 5	21 5	—
4-4-40	10 0	14 0	—
Perenox	10 0	14.0	—
Copper-A	13 5	10 5	—
Dithane	62 0	—	38 0
Zerlate	92 0	—	68 0
Check	854 0	—	—
Mean of Sprayed Plots	24 0	106.0	106 0

The plots were harvested on October 10 and the tubers were graded and weighed after a four-week storage period It was found that the plots on which 4-1-40 and 4-2-40 Bordeaux mixtures were used yielded approximately thirty bushels more per acre than the plots sprayed with 4-3-40 and 4-4-40 Bordeaux mixtures Yields are shown in table 3. The low-lime Bordeaux mixtures gave the highest yields and the most effective control of late blight of the entire group of fungicides tested

RESULTS FOR 1946

The season of 1946 was very dry and it was found necessary to disseminate spore suspensions over the experimental field four times to build up an epiphytotic Yield differences among the treated plots were small but the low-lime Bordeaux mitxures once again showed a superiority in the control of late blight as indicated in table 4.

TABLE 3.—*Total yield of tubers.*

Treatment	Yield in Bushels per Acre			Deviation from Mean	
	1945	1946	Mean	Plus	Minus
4-1-40	291 7	306 6	299 1	9 4	—
4-2-40	286 3	296 5	291 4	1 7	—
4-3-40	259 8	310 2	285 0	—	4.7
4-4-40	257 6	304 3	281 0	—	8 7
Perenox	286 3	303 7	295 0	5 3	—
Dithane	277 5	295 9	286 7	—	3 0
Copper-A	258 9	——	——	—	—
Zerlate	275 1	——	——	—	—
Tri-Basic	——	303 7	——	—	—
Basi-Cop	——	286 1	——	—	—
Check	249 1	268 7	258 9	—	—
Mean of Sprayed Plots	274 2	300 9	289 7		

TABLE 4.—*Annual losses from late blight tuber rot.*

Treatment	Percentage of Total Weight Lost					
	1943[1]	1944[2]	1945[3]	1946[4]	Mean 1943-1946	Mean 1945-1946
4-1-40	—	0 5	0 2	0 3	0 3	0 3
4-2-40	0 1	4 5	0 2	0 6	1 4	0 4
4-3-40	0 1	9 0	1 2	0 6	2 7	0.9
4-4-40	0 8	12 7	0 4	1 1	3 8	0 8
Perenox	0.6	5 3	0 5	2.7	2 3	1 6
Copper Hydro 40	0 6	—	—	—	—	—
Coppesan	1 8	—	—	—	—	—
Dithane	—	—	3 3	1 5	—	2 4
Copper-A	—	—	0 5	—	—	—
Zerlate	—	—	4 8	—	—	—
Tri-Basic	—	—	—	1.0	—	—
Basi-Cop	—	—	—	2 4	—	—
Check	0 8	23 8	6 4	16 0	11 8	11 2
Mean of Sprayed Plots	0.7	6.4	1 4	1 3	2.1	1 1

[1]Seven applications; [2]seven applications; [3]five applications, [4]seven applications

It is planned to use a larger number of replicates in the 1947 field tests in order that certain factors that may introduce errors, such as soil differences, will be greatly reduced.

SUMMARY

Field experiments conducted from 1943 to 1946 have shown that Bordeaux mixtures in which the amount of hydrated lime is not greater

than one-half the amount of copper sulphate are the most effective types of Bordeaux mixtures against late blight of potato, and plants so sprayed give the highest yields.

Acknowledgment

The suggestions of Dr G D Steel, Principal of Prince of Wales College, Charlottetown, during the preparation of the manuscript are deeply appreciated

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SECTIONAL NOTES

INDIANA

Our weather conditions were good for the fall harvest. The potatoes matured nicely with very little skin damage. The Katahdin, Sebago, Chippewa, and Sequoia acreage is on the increase whereas Irish Cobbler and Rural varieties are losing ground

We have some good yields again this year with a number of growers topping the 400-bushel mark during our dry season. The state production is almost 25 per cent below last year's crop and 30 per cent below the average with 3,700,000 bushels This will mean approximately only a bushel of potatoes *per capita* when our average consumption is more than 2½ bushels Our commercial growers are estimating on 35,000 for 1948 (Nov 4) —W. B. Ward

MAINE

Aroostook has not experienced the disastrous forest fires which have swept several areas of Maine, but the drought has seriously affected the potato industry. Because of the lack of water to generate power the county was placed on a rationing schedule. The county was divided and the two areas were given power on an alternating schedule, each two hours This means that electricity is available every other two hours during the day. This has raised problems with shippers as all graders and hoists are electrically driven. Power is available from 11 P. M. to 7 A. M for every one, so many shippers are operating on a night shift. Some shippers have purchased generators for their own use and these shippers are getting along well.

Despite the power shortage the shipments compare favorably with last year's shipments for this period.

Farmers expect another rise in the crop estimate for November but they are still confident that potatoes will bring a good price. The government has purchased about 1,671 cars at support prices. Practically all of these cars are being stored and may eventually affect the market

The crop is coming out well, with field frost somewhat of a problem with individual farmers All in all, this appears to be one of the best crops ever produced in Maine.

Sturges Dorrance, Advertising Counsel to Maine, was the speaker at the Aroostook County Farm Bureau annual meeting on the 5th of November His report on the value of advertising in selling Maine potatoes was instructive Many folks heard, for the first time, just how advertising has helped popularize Maine potatoes

Harry Umphrey, of Presque Isle, is the new president of the Aroostook Farm Bureau.

To date shipments from Maine total 5,560 which is about 1,400 cars less than last year Our shipments have slowed up because of the fact that many farmers have stored their potatoes and are waiting for the January support price, which promises to be higher (Nov. 10).—VERNE C. BEVERLY.

MICHIGAN

Michigan has just completed harvesting the lightest crop in thirty years.

As we reported earlier in these Sectional Notes planting operations took place later than usual, but our growing conditions were so good that vine growths were normal However, only local showers prevailed from late July until early September, with few of them in most places. Then frost came about the 20th of September. Instead of a good crop, which the vine growth would normally indicate before the frost, our yields were very disappointing.

Our certified seed is of very good quality but small in size. The acreage planted was about 25 per cent of normal, and our yields were reduced about 35 per cent (Nov 10) —H. A REILEY.

NEBRASKA

The long drawn out Indian Summer finally came to an end the last week in October Until that time the western Nebraska area had been favored by extremely pleasant and favorable harvest conditions. As a result, many growers delayed their harvest until that late date, in order to take advantage of all growing weather possible This was an advantage that was necessary to offset the extremely late planting and unfavorable growing conditions during the summer.

Despite the late, favorable fall, the crop will fall short of average yields under both dry land and irrigated conditions. In most places, the dry land crop will be about one-fourth of what it was a year ago This,

coupled with the fact that the potatoes are extremely small, and in some cases, emerged through the hard ground that caused mechanical injury, gives us a poor dry land crop. Irrigated conditions were somewhat more favorable, however. It is considered that irrigated yields will be below normal by about 25 or 30 per cent Specifically, many dry land yields will be approximately 40 to 50 bushels, with very few running over 75 Irrigated yields will be around 250 to 300, whereas it is customary to have 100 bushels per acre more.

Because of the favorable fall, in fact, in some cases it was too warm, there were reports of potatoes arriving at terminal markets in a spotted condition. Generally this was caused by sun scald However, that condition has been cleared up Our later shipments have arrived in a good condition

At this time, because of the erratic table stock market, a very few seed sales have been made The opening prices on certified seed potatoes were at $3 50 per cwt. f. o b to the grower. Later sales will probably be at a higher price Some shipments of certified seed are going out at this time, destined for the lower Rio Grande Valley of Texas The majority of the shipments, however, will not go out until January, when seed will move into the other Gulf Coast States of Louisiana, Mississippi, Alabama, etc

Because of the very good crop of wheat, sugar beets and beans, at this time it is difficult to say what the estimated acreage of the 1948 crop of potatoes will be A further reduction in the acreage is anticipated. (Nov 11) —MARX KOEHNKE.

NEW JERSEY

All of the commercial crop in New Jersey is now harvested and nearly all of it sold A few thousand bushels of Green Mountains, Katahdins and Mohawks have been placed in storage for sale during the winter months. Seed growers are finishing their harvesting of "second croppers" and, because of the extremely dry weather during the growing season, the yields are very low

The state goals for potatoes in 1948 were released by the P&MA in September and New Jersey was given the same goal as last year. Since that time the government has had to purchase increasing quantities of our production and P&MA is now requesting a reduction in the acreage of several early and intermediate states including New Jersey. At a recent meeting of the state committee the growers were of the opinion that New Jersey should not be requested to reduce its acreage unless the other states took an equivalent cut The relatively large quantity pur-

chased by the government was in part caused by the large quantities of potatoes being offered for sale by other states during our normal marketing period With average potato yields throughout the country showing substantial increases in recent years, the national acreage must be reduced in order to prevent the production of surplus potatoes Our New Jersey growers are willing to take a proportionate cut in acreage but do not want to be unjustly treated In addition to reducing the acreage New Jersey growers must extend their marketing season into the winter months and thus reduce the excess quantities of potatoes offered for sale during July and August More adequate storage space is a partial answer to the problem of large government purchases and some New Jersey growers are planning to build such facilities (Nov. 13, 1947)—JOHN C. CAMPBELL

NEW YORK

The potato crop throughout up state New York was frozen down the night of the 22nd of September. Since that time we have had very dry weather and the crop is now harvested in much better condition than usual. The tuber color is bright, clean, and the size is good

Because of the late planting and an early freezing, the yield was not high this year. It was probably the shortest growing season we have experienced in several years. However, with the medium-sized crop, we have no excessive sizes Although we will have more than the usual amount of small ones this is not regarded as a serious disadvantage, since many of our growers are seed producers.

Seed producers are generally not only well pleased with the size but also with the appearance of their crop Although the total crop will be light, we anticipate good prices which ought to balance this condition.

There seems to be a mild interest in marketing agreements, but to date the interest is to learn how they might function rather than the actual plan for setting up an agreement

The table stock market is good at support levels or above. Some sales are now, during the latter part of October, being made at the November level.

Reports will soon be available on the performance of some of the new varieties Preliminary indications show the Ontario to be living up to its reputation for scab-resistance and high yields Some of the so-called Blight Immunes will now be called Blight Resisters On the whole, they gave a good performance, both as to blight resistance and high yields Some varieties will be eliminated within the next few years. Tetons were tried quite extensively with varying results. It is a heavy

setter and where they had plenty of moisture high yields were obtained. This variety is reported to be an excellent shipping potato and resistant to Ring Rot. (Oct 29) —W. J. Evans

OREGON

Klamath Basin potato crop was harvested under favorable weather conditions Our acreage was 16,000 as compared with 24,000 in 1946.

Our yields were reduced from 15 to 20 per cent, and our shipments are, generally, estimated to be under 60 per cent of last year.

There is a tendency for growers to store their potatoes for a later market Shipments to date are rather light, about 50 per cent that of 1946

Although our seed acreage has been reduced, the quality has improved compared with that of last year. (Nov 5).—C. A Henderson.

Our field inspections have been completed under our 1947 program for seed potatoes. We are just starting our bin inspections and certain acreages might be rejected due to certain troubles found in the bin We now have field-test requirements before any Netted Gem seed can be tagged and these requirements must be met. Seed from all our Netted Gem lots has been planted in Southern California in connection with this program. We expect to make readings on these lots some time in January Our foundation seed lots, which compose mainly the White Rose variety, will be planted in the greenhouses on the college campus at Corvallis Here again, before eligible for our purple foundation tag, each lot must meet with the requirements for foundation seed.

The acreages that passed field inspections by varieties are as follows Bliss Triumph, 10 acres; British Queen, 8; Burbank, 208; Calrose, 7, Chippewa, 2, Earliest of All, 32.9; Early Rose, 2.55; Epicure, 0.2, Gold Coin, 8; Great Scot, 1; Irish Cobbler, 1.5; Katahdin, 10; Netted Gem, 1,571 75; Pontiac, 0 75; Teton, trace; White Rose, 1,201.15 acres.—with a total acreage of 3,064.80.

In the Netted Gem variety we have 51.8 acres eligible for foundation tags and 1,519 95 acres eligible for the certified grade providing each makes its respective requirements. The White Rose acreages (528.95) are eligible for foundation based on field inspection and 672 2 acres have passed as certified. These two varieties are our leading ones at this time in connection with our foundation seed program (Nov. 6) —H. E. Finnell.

CANADA

A heavy white frost about the first of October killed most of the potato foliage in Prince Edward Island Harvesting operations have been in full swing all month, with growers reporting fair to good or excellent yields Bin inspections started on the 6th of October Little or no blight, but considerable scab, has been present. Active shipping has been delayed as much as possible to allow tubers to harden

Reports received from New Brunswick show that a total of 15,515 acres passed inspection this year. The main varieties included in this figure are Katahdin 9,984 acres; Green Mountain 3,061; Bliss Triumph, 1,439; Irish Cobbler, 665, Sebago, 231, White Bliss, 117, and Pontiac 10 acres. In Nova Scotia, a total of 1,206 acres passed inspection, the principal varieties being Katahdin, 574 acres; Bliss Triumph, 185, Irish Cobbler, 171; Green Mountain, 131; Sebago, 101; Warba, 16; Garnet Chili, 10; and Sequoia, 6 acres The total acreage passing inspection in Ontario is 2,364; and the main varieties are as follows: Katahdin, 1,498 acres; Chippewa, 365; Irish Cobbler, 245; Green Mountain, 119; Sebago, 67; Rural New Yorker (Dooley), 45; and Warba, 13 British Columbia fields passing inspection totalled 2,270 acres, and the main varieties are Netted Gem, 1,422 acres; White Rose, 420; Green Mountain, 115; Warba, 91; Early Epicure, 65; Katahdin, 33, Columbia Russet, 14; Chippewa, 19; Wee McGregor, 13, and Burbank, 13. Reports for other provinces were included in the "Sectional Notes" for October. (Oct 31) —W W. KEENAN

PROVINCE OF ONTARIO

The demands for potatoes continue to be keen with prices showing improvement Large quantities are being moved by truck and there is an active movement of carload shipments from local centers American buyers have purchased several carloads of Foundation A grade Katahdins at $2 25 per 75-pound bag at local shipping point The quality of Ontario potatoes reaching markets has improved and many consumers are now giving preference to local products Sales of pre-packaged potatoes have increased. Enforcement of Farm Products Grades and Sales Act has resulted in several convictions at various centers

The Provincial record of 684 bushels per acre for yield was broken this year by three growers from Parry Sound District as follows· Fred Sohm, Magnetawan, 718 bushels per acre; C H. Chapman, Nipissing, 694; and Frank Rick, Trout Creek, 693 bushels The average for 21 contestants completing the Parry Sound District 500 Bushel Club was

460 bushels per acre, whereas the average for the first ten high contestants was 593 bushels. Seventeen similar clubs completed contests in 1947.

The annual survey for bacterial ring rot has now been completed with a number of cases less than one-half of a year ago. Most cases were trace infections probably caused by disease organisms spreading by used bags containing diseased seed.

The prices on Toronto market continue to be the lowest of any in the Province with quotations for Canada No. 1 grade Ontario potatoes Monday, November 10th, wholesale to retail at $1.75 to $1.90 per 75 lb bag Our prospects, however, look promising for a firm market (Nov 10) —R E GOODIN

WHAT'S AHEAD FOR THE POTATO INDUSTRY

Every one interested in the potato industry is concerned as to what is to happen after next year when the present price support plan is terminated. Various suggestions are being made concerning the procedures to adopt to maintain a sound industry. At the hearings before the Hope Committee, representatives from the different potato-growing sections were given an opportunity to present their recommendations.

At the meeting of the Hope Committee at Durham, New Hampshire, on October 13, the following statement was presented by Clifford G. McIntire of Maine As Mr. McIntire points out, he spoke for himself and it is entirely possible that some of his fellow potato growers in Maine may not agree with his suggestions. He did, however, make a number of interesting suggestions to the committee. It would be helpful if other statements, presented to the Hope Committee, could be printed so that potato growers in different parts of the country could be acquainted with the thinking in competing areas.

TESTIMONY PRESENTED BY CLIFFORD G. McINTYRE OF PERHAM, MAINE, BEFORE HOUSE AGRICULTURAL COMMITTEE AT DURHAM, N. H., OCTOBER 13, 1947

Mr. Chairman, members of the Committee; I am speaking as a potato grower with my home being on a farm in Aroostook County, Maine I am speaking for myself only, as I represent no organization or group of growers and I speak solely as a producer.

The potato industry in Maine represents an important part of the agriculture of the state. About 6,000 farm owners raise potatoes on a

commercial basis. The 1947 crop is estimated to total over 58,000,000 bushels or 16 per cent of the potato crop of the United States. In 1947, Maine planted 183,000 acres to potatoes and approximately 85 per cent of the acreage is located in Aroostook County. The potato growers of Maine have a capital investment in land farm improvements of more than $50,000,000, personal property, which is about wholly equipment, of $18,000,000, and an investment in the current crop, just now being harvested, of at least $36,000,000, a total capital investment of more than $104,000,000. The potato industry of Maine has made substantial financial gain over the past eight years, and at the present time farm real estate mortgage indebtedness is relatively low, however, increasing costs of production during the past few years have brought us to the point where the cost of producing the crop is at an all time high. In spite of substantial equities and savings on the part of individual farmers, credit facilities are used extensively in the production of each year's crop. It is my estimate that in producing the 1947 crop, over $16,000,000 have been borrowed by our potato growers, these loans being made by Production Credit Associations, commercial banks, Farm and Home Administration, private individuals and corporate organizations.

Irish potatoes are grown commercially in practically every state in the Union. With the importance of this industry to Maine farmers, I am sure you can appreciate that any long range policy for agriculture in this country is of vital concern to a potato grower in Maine The business of producing high yields of the finest potatoes grown in the country has been our job for years Nature has provided us with ideal soil and climatic conditions However, nature and geography have made it essential that we stake our future almost solely on potatoes as the short season and distance to market seriously limit our opportunity for any material diversification of our farm income.

In the consideration of a long range policy for agriculture there are many problems of a national and international aspect that are beyond my comprehension This world food problem has tremendous implications at the present moment Our agricultural leaders at the national level are in a better position to evaluate the production capacity of American agriculture and the world needs than a small producer out in the country The American farmer has given reasonable evidence of his ability to produce in supporting our war effort with limited facilities at his disposal, so, given adequate equipment, fertilizing materials and labor, I believe he can push even higher the production capacity of his farm. A healthy people is essential to a strong nation and as a producer I am interested

in helping to provide the consumer with potatoes as a part of this healthy diet.

The potato industry as a whole has experienced wide fluctuation of prices and income to farmers. It has not been alone in this respect and together with many other producers we have enjoyed prosperous years, and have struggled through the depths of depression. With agricultural income representing such an important part of our whole national economy, it seems to me that it is to the public interest that agriculture as a whole be maintained on a sound stable basis. Although the American farmer in general, and the Maine farmer in particular, prefer to think of themselves as self-reliant individualists, however, they realize, I believe, that their economic well-being is so closely interwoven with other farmers of the country and all phases of industry that they must look to sound over-all programs in order to assure their own well-being.

It is my opinion that a price support program is a legitimate part of a sound long-range program for the potato industry. The program should be based on a parity formula that includes farm labor as a factor in the cost of production I believe that a support program for the potato industry at 90 per cent of parity promotes expansion within the industry, has a definite inflationary effect on land values and requires close control of the acreage to be planted It is my opinion that any support program should be at a level which is below cost of production I believe support at a "loss level" would promote better farm practices, and reward personal initiative. It would take out of production land not adapted to potatoes and in effect would tend to control the acreage without acreage allotments The proportion of parity price at which support would be made effective could be varied from year to year as increase of production was needed, being lowered if surplus seemed apparent. The support program should provide for handling the surplus by diversion of low grades to by-product use and shipment of better grades for export When surpluses exist, special emphasis should be placed on marketing only the most desirable portion of the crop in order that the consumer might benefit in having a quality product available. In my opinion any support program should be made effective at the grower level, permitting the consumer to buy at a price that reflects the supply of potatoes available. In periods of surplus and in periods of normal supply, off-grade potatoes should be directed to by-product use. We have in Maine, by-product facilities to handle 400,000 bushels of potatoes per week. This seems like a substantial quantity but at times in the past, these facilities have hardly been adequate Although I believe the processing of off-grade potatoes should be handled by these private facilities to their maximum capacity,

however, in order to assure the producer of maximum return for this portion of his crop and to assure full use of any surplus which might exist, it might be found advisable for the government to have available a stand-by plant for industrial alcohol located in the central part of the producing area.

Supplementing the support program, I believe a great deal more emphasis should be placed on research in marketing and by-products. We should continue our research in production and farm management We need maximum yields per acre to reduce our cost per unit of production. However, the means of getting the best product possible to the consumer in a manner that encourages more full use of our product is a field of research that has had far too limited attention in the past This research should be more than the assembling of figures It means new designs in farm equipment, new designs in warehouses, new designs in graders, new designs in transportation facilities and new methods of packaging and distribution to the consumer Full use of this type of research coupled with a price support program below the cost of production will, I believe, remove much of the threat of surpluses in our industry.

With our own future at stake and our responsibility to other peoples in our world economy, we must place more emphasis than ever before on soil conservation and soil reserves The educational facilities of the Extension Service, the work of the Production and Marketing Administration, the extension of agricultural credit, and phases of Federal, State and County agricultural activity should emphasize anew the need of saving our soil, timber and other resources of our farms. In my opinion the establishing of a soil-fertility reserve merits very careful study. In Maine it might logically develop into a substantial improvement especially in our timber reserves, which have been seriously depleted. The Soil Conservation Service has made substantial progress in the intensively cropped areas of Aroostook. There is a great deal more work to be done. Their program of strip-cropping and contour farming is a radical change from our large fields and straight rows. However, the results are now generally accepted and the Soil Conservation District in the county has agreements on hand to cover two full years of work, with other farmers asking for assistance.

With the equipment which is now becoming available, the labor problem in the potato industry in Maine is well in hand, except at harvest time We have little or no problem in regard to displaced farm labor. Our seasonal labor problem at harvest time is serious and it has been only by the assistance of labor imported from the south central states and Canada that we have been able to harvest our crop successfully dur-

ing the past four years Special emphasis is needed at once on research leading to the design of a practical potato harvester. Until that machine is available we shall need to import, as we have this year, at least 7,000 workers to assist in the harvest. This fall all of our help has been imported from Canada. Negotiations for this labor must of necessity be carried on between the two governments involved. I believe a substantial portion of the cost should be borne by the farmers.

In conclusion, as a potato grower from Maine, I believe we should make an effort to perfect our farm programs along lines that promote personal initiative and reward diligent effort. I believe we should have a program that encourages good farm practices but does not retain poor land or poor farmers in commercial production at government expense, a program that conserves our agricultural resources and assists the farm operator to be a farm owner and the best farmer possible, producing the best quality crops at lowest costs, getting a maximum part of that production to the consumer and one that promotes maximum use of that product by the consumer. I believe we must have a program that encourages young men to continue on our farms Credit facilities must be sound, conservative in good times and courageous when operating margins are narrow We need government assistance in coordinating these farm programs but administration should be at state and county levels, guided by farmers in local communities.

PROGRAM OF THE ANNUAL MEETING OF THE POTATO ASSOCIATION OF AMERICA

December 28, 1947 to December 31, 1947

Chicago, Illinois

President, MARX F KOEHNKE, *Nebraska Certified Potato Growers,* Alliance, Nebr

Secretary, REINER BONDE, *University of Me*, Orono, Me

Sunday Afternoon, December 28, Palmer House, Private Dining Room 9.
1 30 P M Society Session—Seed Certification Problems

HENRY M DARLING, *Presiding*

Report of Potato Breeding Committee for 1947 G H RIEMAN

Progress of Virus and Bacterial Disease Investigations in 1947 JAS H JENSEN

Insect Investigations in 1947 ROSCOE E. HILL

Round Table Discussion· Report on Bacterial Ring Rot Survey

Miscellaneous Problems

Monday Morning, December 29; Palmer House, Private Dining Room 9

9.00 A M.—Society Session

MARX F KOEHNKE, *Presiding*

1. *Report of Potato Research Committee* (20 min.) E. V HARDENBURG, Cornell University, Ithaca, N Y.
2. *Resistance of New Potato Varieties to Common Scab in Wisconsin* (10 min) G. H. RIEMAN, University of Wisconsin, Madison, Wis
3. *Report of Harvest, Transportation and Storage Committee.* (20 min.- J M LUTZ, U S. Hort. Field Station, Meridian, Miss
4. *The Effect of Chemical Vine Killers on the Quality and Yield of Red McClure and Triumph Potatoes* (12 min) R KUNKEL and A. M BINKLEY, Colorado A & M College, Ft. Collins, Colo. W. C. EDMUNDSON, U S Potato Field Station, Greeley, Colo
5. *The Relationship between Maturity, Yield, Color and Cooking Quality of Bliss Triumph Potatoes.* (12 min) R. KUNKEL, L. A SCHALL and A M BINKLEY, Colorado A & M College, Ft. Collins, Colo
6. *The Testing of Varieties as It Applies to a Potato Improvement Program* (12 min) E. J. WHEELER, Michigan State College, E Lansing, Mich
7. *Combining Value of Parents for Resistance to Common Scab.* (15 min) F A. KRANTZ and CARL J. EIDE, University of Minnesota, St. Paul, Minn.

8. *Pollen Sterility in Solanum demissum-tuberosum hybrids* (5 min) PAUL YAGYU and HUMBERTO GANDARILLAS, University of Minnesota, St. Paul, Minn.

9. *Relationship of Pressure Tester Readings to Specific Gravity in the Potato* (10 min.) O C TURNQUIST, University of Minnesota, St Paul, Minn.

10 *Plants from Fasciated Sprouts of a Potato Tuber* (5 min.) W. A. OITTO, University of Minnesota, St. Paul, Minn.

11. *Nomenclature, Pedigrees and Breeding Programs* (10 min.) DONALD REDDICK, Cornell University, Ithaca, N. Y.

12 *Louisiana Releases Three New Varieties of Potatoes* (10 min) JULIAN C MILLER, Louisiana State University, Baton Rouge, La.

Monday Afternoon, December 29, Palmer House, Private Dining Room 9

1:30 P. M Society Session—Business Meeting

3 00 P M Presentation of Papers

MARX F. KOEHNKE, *Presiding*

1 *Influence of Thiourea on Set and Size of Potato Tubers* (12 min.) (Lantern) ORA SMITH, J H ELLISON and FRED McGOLDRICK, Cornell University, Ithaca, N. Y.

2 *Relation of Potassium and Magnesium to Potato Yields* (12 min.). (Lantern) ORA SMITH, FRED McGOLDRICK and J. H ELLISON, Cornell University, Ithaca, N Y

3 *Carlot Storage and Shipping Tests with Nebraska Triumph Seed Potatoes for Southern Midwinter Planting.* (20 min) H O WERNER, University of Nebraska, Lincoln, Nebr

4 *Some Experience with Shell Cooled Bins for Storing Seed Potatoes* (15 min) H O WERNER, University of Nebraska, Lincoln, Nebr

Monday Evening, December 29, Palmer House, Club Floor Room 18

8 00 P M—Society Smoker and Round Table Discussion

O D. BURKE — W N KEENAN, *Presiding*

Tuesday Morning, December 30, Stevens Hotel, South Ballroom 1

9.00 A M Joint Session with American Phytopathological Society

O D. BURKE, *Presiding*

1. *Forecasting Late Blight in Eastern Virginia in 1947* (12 min) (Slides) HAROLD T COOK, Virginia Truck Experiment Station, Norfolk, Va

2 *Some Histological Features of Potato Stem Necrosis Associated with Actinomyces scabies* (15 min) (Lantern) W J HOOKER, Iowa State College, Ames, Iowa

3 *Evidence of Parasitic Activity of Actinomyces scabies on Seedling Roots.* (15 min) (Lantern) W J HOOKER and J E SASS, Iowa State College, Ames, Iowa

4 *A Virus Causing Internal Necrosis in White Rose Potato.* (15 min) (Lantern) JOHN W. OSWALD, University of California, Davis, Cal

5. *Chemicals for Control of the Golden Nematode of Potatoes* (5 min) (Lantern) C G SCHMITT, Boyce Thompson Institute, Yonkers, N Y

6. *Potato Vine Killers* (12 min) (Lantern) WM. G. HOYMAN, N D. Agricultural College, Fargo, N D

7. *A Comparison of Corynebacterium sepedonicum Inocular from Resistant and Susceptible Potato Varieties* (12 min) (Lantern) G H. STARR and W. A RIEDL, University of Wyomlng, Laramie, Wyo

8 *Indicator Plants for Studies with the Leaf Roll Virus of Potatoes* (15 min) (Slides) HUGH C. KIRKPATRICK, Cornell University, Ithaca, N Y.

9. *A Comparison of Chemical Tests with the Ultraviolet Technique in Testing Potatoes for Virus Content* (15 min) (Lantern) J G McLEAN, Kern County Seed Potato Assn , Bakersfield, Cal ROBERT KUNKEL and GEORGE LANE, Colorado A & M College, Ft Collins, Colo

10. *Physalis angulata* (Ground Cherry) *an Indicator for the Potato Leaf Roll Virus* (10 min.) CHAS. HAVEY and REINER BONDE, University of Maine, Orono, Me

11. *Potato Spraying in Maine for the Control of Diseases* (10 min) REINER BONDE, University of Maine, Orono, Me

12 *Some Fundamental Things We Do Not Know about Virus Diseases of Potatoes* (12 min) E L WALDEE, Utah State Agricultural College, Logan, Utah

Tuesday Afternoon, December 30, Palmer House, Private Dining Room 9

1:30 P M—Society Session.

GEORGE M LIST, *Presiding*

1. *Fertilizer and Culture Studies in* 1947 (20 min) JOHN BUSHNELL, Ohio Agricultural Experiment Station, Wooster, Ohio

2 *The Effect of Leafhopper Control with DDT Dust on Length of Growing Season, Quality and Yield of Seventeen Potato Varieties* (15 min) (Lantern) M B LINN, J W. APPLE and C Y. ARNOLD, University of Illinois, Urbana, Ill

3 *Results of the* 1947 *National Cooperative Potato Spray Fungicide Experiment* (15 min) W F BUCHHOLTZ *et al,* State College of Agriculture, Ames, Iowa

4 *Soil Fertility Investigations with Potatoes in Wisconsin* (12 min.) K C BERGER, University of Wisconsin, Madison, Wis

5. *The Effect of Temperature, Moisture and Nitrogen on the Development of Leaf Roll Symptoms in the Irish Potato* (12 min) M W FELTON, Nebr Certified Potato Growers, Alliance, Nebr

6 *The Development of Stem End Discoloration in Bliss Triumph Potatoes Held in Warm Storage* (12 min) M W. FELTON, Nebr Certified Potato Growers, Alliance, Nebr

7. *Promising New Chemicals for the Control of Insects and Diseases* (10 min) JOHN C CAMPBELL, N. J Agricultural Experiment Station, New Brunswick, N J.

8. *The Effect of Different Rates of Application of* 2-4D *on the Yield of Potatoes* R H BRADLEY and N K ELLIS, Northern Indiana Muck Crops Experiment Station, North Liberty, Ind.

9 *Results from Spraying and Dusting Potatoes* 12 min) R L POST and WAYNE J COLBERG. N D Agricultural College, Fargo, N D.

10 *Use of Certain New Materials in the Control of Potato Insects in Michigan* (10 min) W F MOROFSKY and J H MUNCIE, Michigan State College, East Lansing, Mich

11 *The Effect of New Insecticides on Potato Production in Minnesota.* (10 min) A A GRANOVSKY, University of Minnesota, St Paul, Minn.

12 *Studies on the Host Range of the Golden Nematode of Potatoes Heterodera rostochiensis* (8 min.) (Projector) W. F MAI and B F LOWNSBERY, JR, Cornell University, Ithaca, N Y

Wednesday Morning, December 31, Palmer House, Private Dining Room 17

9 00 A M Joint Session with American Society for Horticultural Science

W N KEENAN, *Presiding*

1 *Chemical Control of Weeds in Potatoes.* (12 min) ORA SMITH, J. H ELLISON and FRED McGOLDRICK, Cornell University, Ithaca, N Y

2 *Effect of Sprout Retardant on Seed Potatoes* (10 min) ORA SMITH, J H ELLISON and FRED McGOLDRICK, Cornell University, Ithaca, N Y

3 *Effects of Spraying a Sprout Inhibitor on Potato Plants in the Field.* (12 min) J H ELLISON and ORA SMITH, Cornell University, Ithaca, N Y

4 *Killing Potato Vines* (10 min) FRED McGOLDRICK and ORA SMITH, Cornell University, Ithaca, N. Y.

5 *The Effects of Plowing and Discing Soils on the Subsequent Yields of Tomatoes, Muskmelons and Potatoes* (10 min) E. P. BRASHER, University of Delaware, Newark, Del

6 *The Effect of Variety and Harvest Date on Yield and Specific Gravity of Alaska Grown Potatoes* (15 min) Z. M. FINEMAN, Agricultural Experiment Station, Palmer, Alaska.

7 *A Mutation for Tuber and Plant Characters in the Russet Burbank Potato.* (10 min) Z M FINEMAN, Agricultural Experiment Station, Palmer, Alaska.

8 *Further Studies on the Use of Sprout-Inhibiting Chemicals for Seed Potatoes* (10 min) HUMBERTO GANDARILLAS and R. E NYLUND, University of Minnesota, St Paul, Minn

9 *Preliminary Studies on the Value of Leaf Analysis of Potato Growth on a Low-Nitrogen Soil* (10 min) R. E NYLUND, University of Minnesota, St. Paul, Minn

10 *Effect of Location and Date of Planting on Yield and Grade of Certain Varieties of Potatoes* (10 min.) (Slides) A J. PRATT, W. C Kelly and G F SOMERS, Cornell University, Ithaca, N. Y.

11 *Yield and Grades of Blight Resistant Potatoes Grown in 20 Different Locations in New York State* (10 min) (Slides) A. J. PRATT, Cornell University, Ithaca, N Y.

12 *The Life Cycle of Potato in Relation to Testing for Yields* (20 min.) (Lantern) T H. HAWKINS, Kern County Seed Potato Assn., Bakersfield, Cal.

All members of the Potato Association of America, planning to attend the meetings in Chicago, December 28 through 31, are urged to register with the AAAS The registration fee helps to defray part of the expense attendant with conducting meetings, payment of room space, and many other necessary expenses. The registration fee entitles each registrant to a copy of the general program, a convention badge, and special descriptive pamphlets furnished by local committees. In addition, the registrant will be listed in the visible directory available for inspection 24 hours a day. The registration fee is $2 00 for members, and $3 00 for non-members Advance registration may be made until December 10 by sending the fee to the following address: American Association for the Advancement of Science, 1515 Massachusetts Avenue, N W., Washington 5, D C.

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EFFECT OF BORON IN FERTILIZER UPON QUALITY OF DEHYDRATED WHITE POTATOES

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Division of Fruit and Vegetable Crops and Disease, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, Beltsville, Md.

INTRODUCTION

The physiological effects of boron on the growth and development of plants have been the subject of very extensive studies by American investigators during the last 30 years The toxic properties of boron and its compounds were the first to receive attention because stoppage of importation of potash during World War I led to the employment in commercial fertilizers of potash salts of American origin, which contained varying but usually considerable quantities of borax (sodium borate, $Na_2B_4O_7$) as an impurity. The application of such fertilizers resulted in widespread injury to various crops, varying from reduction in vigor and yield to complete failure to develop. Studies of the cause of the injury undertaken by numerous investigators very quickly showed conclusively that it was attributable to the presence of borax in the fertilizer, and it was demonstrated that definite damage to a wide

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variety of crop plants resulted from applications of borax as low as 3 to 10 pounds per acre (4,5,3,12,10).

In the case of the potato (2, 13, 11, 1) it was shown that there was somewhat greater tolerance of borax than in the case of beans, corn, and some other crops. It was also found that with potatoes amounts too small to produce injury were beneficial, stimulating growth of tops and thus possibly increasing yields. Brown (2), for example, found that 1 to 3 pounds of borax per acre applied in the furrow, or 4 to 5 pounds broadcast at the time of planting potatoes, gave an increase in yields, whereas 10 pounds or more resulted in definite lowering of yield, regardless of the method of application

The general result of these and other investigations carried out during the period 1916 to 1922 was that the presence of borax in any amount in a fertilizer came to be generally regarded as harmful, and fertilizer manufacturers accordingly took steps to reduce the amounts present in their products to mere traces Boron injury to crops thereupon practically ceased to occur.

As an increasing number of workers have taken up the study of the functions and physiological roles of the minor or trace elements in plant nutrition, boron again became the subject of intensive investigation, and it has been said that its effects have been more extensively studied in recent years than those of any other element (9) This more recent work has confirmed the results of the earlier investigators in showing the highly toxic effect upon plants generally of boron in excess of a very small quantity, which varies somewhat with the type of plant, the climatic conditions, and other factors It has also shown that the presence of boron in amounts below the toxic level is essential to the normal growth and development of plants, and that a deficiency of boron in the soil or nutrient solution results in characteristic symptoms of boron starvation. Boron deficiency is especially apt to occur in soils high in calcium content, as a certain balance between calcium and boron in the plant is necessary to normal development.

In the potato, very severe interference with growth of both tops and roots, wholly preventing tuber formation, has been reported for plants grown in completely boron-free nutrient solutions or sand cultures. In the field, boron-deficiency symptoms are confined chiefly to the tubers, and effects upon vines, if they appear at all, are apparent only late in the season. As summarized by Jones and Brown in 1941 (7), the injury to tubers consists in reduction in size and brown discoloration of the flesh, especially at the stem end. Smith and Nash

(14) stated that potatoes grown without boron were deficient or flat in flavor, very wet, and sloughed badly in boiling, but blackening did not occur in the variety used (Smooth Rural). Workers at the Vermont Agricultural Experiment Station (6) reported severe dwarfing, wateriness, and generalized internal browning in tubers of boron-deficient plants, with susceptibility to early blight, which did not attack checks receiving boron.

The results of these and similar investigations have led to the systematic addition by a number of manufacturers of small, definitely measured amounts of boron, usually in the form of sodium borate, to commercial fertilizers designed for use upon truck crops or potatoes. While it is quite generally agreed that such additions are beneficial for a number of vegetables under certain conditions, opinion does not appear to be unanimous as to their effects in the case of potatoes. Whether small applications of boron decrease the tendency of potatoes to darken in cooking has also been the subject of considerable discussion.

Purpose and Scope of the Present Work

In the present work a comparison is made between the dehydrated products made from potatoes of the same varieties, grown side-by-side upon the same soils, with and without the addition of boron to the fertilizer applied.

The potatoes employed consisted of U S. No. 1 stock of the varieties Katahdin and Green Mountain grown in a field test of effects of fertilizer with added boron *versus* no boron, conducted in Aroostook County, Maine, by the Summers Fertilizer Company, Inc, of Baltimore, Md They were supplied for the study by courtesy of J E. Totman, president of that company, to whom the writers desire to express their appreciation for the opportunity to carry out the present study. The material of each variety consisted of stock grown on each of four farms differing only slightly in their levels of fertility; that from each farm consisted of two lots of several hundred pounds each, one grown with and the other without boron added to the fertilizer used

The fertilizer applied to the plots receiving no boron was a 5-7-10 formula, of which 2,500 pounds per acre were applied at planting as side bands 2 inches from the seed The fertilizer containing boron was a 6-9-15 formula to which sodium borate had been added at the rate of 10 pounds per ton This was applied at the rate of 1,500 pounds per acre at the same time and in the same manner as the other

fertilizer. It may be noted that the two fertilizers differed considerably in other respects than in presence or absence of boron The no-boron treatment supplied 125 pounds of nitrogen, 175 of potash (K_2O) and 250 of phosphoric acid in comparison with 90, 135, and 225 pounds, respectively, of these nutrients in the boron-containing fertilizer. The amount of sodium borate applied per acre was 7½ pounds.

Participation of the writers in the experiment was limited to work with mature potatoes supplied them by shipment to Beltsville after harvest. One of the writers saw the plantings in midseason. The plots were all uniformly Caribou loam of moderate productiveness and were of considereable size, occupying several acres on each of the four farms. No differences in growth and vigor of the plants under the two treatments were detectable in midseason. The writers are informed that although no exact yield data were taken, no significant differences in yields between treatments were observed at harvest. They are also informed that it was the belief of a dehydrator operator* in the area that the product made from Green Mountain potatoes receiving added boron in the fertilizer was upon the whole somewhat better than that made from the same variety receiving no boron

The various lots of the variety Katahdin were assembled and shipped to Beltsville, Maryland, within a few days after they were dug; the material of Green Mountain was held in storage at Presque Isle, Maine, for about 2 weeks prior to shipment Upon receipt at Beltsville, each shipment was held in storage at 60° F for approximately 3 weeks after which portions of each lot were dehydrated, as described in the next section The dehydration of Katahdin was carried out on the 1st of December and that of Green Mountain on the 18th of December, 1944. The remaining material was held in storage at 60° until the 16th to 18th of February, when it also was dehydrated.

A careful comparison of the various lots of boron-treated potatoes with the check lots receiving no boron was made prior to and during the preparation for drying in December and repeated with the material dried in February. There were no discoverable differences between the potatoes from the two fertilizer treatments in smoothness, surface cracking, stem-end browning, net necrosis, presence of decay, or other respects.

Preparation and Drying of the Material

All material was inspected before peeling, and any visibly decayed tubers were removed and weighed The sound stock was then

*Summers Fertilizer Co, at their dehydrating plant at Winterport, Maine.

TABLE I.—*Condition of raw stock, losses in peeling and trimming, and yields of dry product as percentages of whole tubers for Katahdin and Green Mountain potatoes grown in four locations with and without application of boron to the soil.*

Variety	Grower	Fertilizer	Date Dehydrated	Percentage Discarded For Rot	Percentage Showing Net Necrosis etc.	Percentage loss in Peeling	Percentage loss in Trimming	Percentage Prepared Strips	Yield of Dry Product As Percent Fresh Whole Stock	Yield of Dry Product As Percent Prepared Strips
Katahdin	Brogdon	No Boron	Dec. 1,'44	Less than 1	0	15.0	3.0	82.0	15.0	18.3
		Boron	Dec. 1,'44	Less than 1	0	13.5	2.6	83.9	15.9	18.9
	Coates	No Boron	Dec. 1,'44	Less than 1	0	14.2	4.5	81.3	14.9	18.3
		Boron	Dec. 1,'44	Less than 1	0	14.6	4.8	80.8	14.4	17.8
	Davis	No Boron	Dec. 1,'44	Less than 1	0	19.0	4.4	76.6	15.4	20.1
		Boron	Dec. 1,'44	Less than 1	0	12.9	5.8	81.3	16.0	19.6
	Hewitt	No Boron	Dec. 1,'44	Less than 1	0	17.4	2.9	79.7	14.2	17.8
		Boron	Dec. 1,'44	Less than 1	0	19.4	3.3	77.3	13.9	17.9
Katahdin	Brogdon	No Boron	Feb.16,'45	Less than 1*	0	17.4	4.3	78.3	14.3	18.2
		Boron	Feb.16,'45	0*	0	17.2	3.8	79.0	16.2	20.5
	Coates	No Boron	Feb.16,'45	2*	0	16.0	4.7	79.3	14.7	18.5
		Boron	Feb.16,'45	1	0	19.8	4.3	75.9	14.4	18.9
	Davis	No Boron	Feb.16,'45	0	0	23.8	2.8	73.4	13.1	17.8
		Boron	Feb.16,'45	4	0	16.1	7.6	76.3	14.8	19.4
	Hewitt	No Boron	Feb.16,'45	0*	0	22.0	2.5	75.5	13.6	18.0
		Boron	Feb.16,'45	1	0	15.3	4.8	79.9	16.4	20.5
Green Mountain	Brogdon	No Boron	Dec.18,'44	Less than 1	Less than 1	16.0	8.9	75.1	17.4	23.1
		Boron	Dec.18,'44	Less than 1	Less than 1	15.6	6.0	79.0	17.2	21.7
	Coates	No Boron	Dec.18,'44	Less than 1	Less than 1	13.6	6.6	79.8	17.0	21.3
		Boron	Dec.18,'44	Less than 1	Less than 1	18.9	10.1	70.0	13.6	19.4
	Davis	No Boron	Dec.18,'44	Less than 1	Less than 1	15.5	6.8	77.7	14.0	18.1
		Boron	Dec.18,'44	Less than 1	Less than 1	11.6	5.4	83.0	15.8	19.0
	Hewitt	No Boron	Dec.18,'44	Less than 1	Less than 1	17.3	5.5	77.2	15.2	19.7
		Boron	Dec.18,'44	Less than 1	Less than 1	16.1	7.2	76.7	15.5	20.2
Green Mountain	Brogdon	No Boron	Feb.17,'45	0	2	24.0	7.3	68.7	16.2	23.5
		Boron	Feb.17,'45	5	1	18.6	10.6	70.8	15.9	22.4
	Coates	No Boron	Feb.17,'45	Less than 1	3	14.3	8.5	77.2	17.6	22.8
		Boron	Feb.17,'45	2	4	14.2	11.7	74.1	16.9	22.8
	Davis	No Boron	Feb.17,'45	10	8	21.8	15.4	62.8	13.1	20.8
		Boron	Feb.17,'45	8	10	20.2	15.7	64.1	13.7	21.3
	Hewitt	No Boron	Feb.17,'45	Less than 1	Less than 1	16.3	7.3	76.4	15.3	20.0
		Boron	Feb.17,'45	6	3	18.0	9.4	72.5	15.4	21.2

* These lots were free of rot but considerable sprouting had occurred.

weighed, peeled by immersion in boiling lye solution of 8- to 10-per cent strength, thoroughly washed to remove lye, and placed in containers of cold 1-per cent sodium chloride (common salt) solution. After inspection and trimming, the potatoes were cut by a stripping machine into random-length julienne strips three-eighths by three-eighths inch in cross section. As cut, the strips were received into a 1-per cent salt solution, again inspected, and any diseased or partially diseased pieces removed and added to the trimmings for weighing with them The strips were then spread on trays and blanched for 6 minutes in flowing steam at 209° to 212° F Stripping, weighing, and spreading on trays were done as rapidly as possible, and the interval between cutting into strips and blanching was never more than 5 to 7 minutes. Upon removal from the blancher each lot of strips was divided into three portions one was placed in the dehydrator without further treatment, one was dipped into 0 1 per cent orthophosphoric acid, and one was dipped into 0 1 per cent sulfurous acid solution made by dissolving SO_2 gas in water The length of dip was in both cases 4 minutes On removal from the dipping solution the strips were drained spread on trays, and placed in the dryer. Drying was carried out in a laboratory dehydrator in a parallel-current air flow of 550 feet per minute. The temperature at outset of drying was 170° to 175°, which was reduced after 4 hours to 145° to 150°. The wet-bulb temperature was 120° at the outset of drying and 105° at the end The material was removed from the drier when it had a residual moisture content approximating 7 per cent A portion of each lot of material was placed in sealed glass containers and the remainder in heavy, closely woven bags Both bags and sealed containers were stored at 70° F until removed for examination and scoring.

Preparation Losses and Dry Yields

Table 1 presents for all the lots of material the data on the percentages of tubers rejected because of decay or diseaase, the losses in peeling and trimming, yields of prepared strips, and yields of dry product as percentages of raw whole stock

In the inspection of the raw stock prior to peeling, any visibly decayed tubers were sorted out. After peeling, a second inspection was made for the purpose of removing decayed tubers and estimating the percentage of potatoes showing evidence of net necrosis, stem-end browning, or other abnormal conditions The results of these inspections are recorded in two columns of the table Decayed tubers or

those which showed general discoloration of most of the tuber were rejected, and hence are not included in the weights upon which preparation losses and dry yields were computed Tubers that showed limited areas of discoloration or net necrosis, which could be removed by trimming, were not discarded, but the percentage of such tubers was determined for each sample.

The potatoes of both varieties that were dehydrated in December were almost wholly free of rot, less than 1 per cent showing decay. The material of Katahdin was entirely free of net necrosis or discoloration, and that of Green Mountain had less than 1 per cent of tubers showing net necrosis. After storage at 60° F. until the 16th of February, the Katahdin material was still free of stem-end browning and necrosis, but some lots had 1 to 4 per cent of decayed tubers, and others, while sound, had begun to develop numerous sprouts. The lots of Green Mountain material from the different farms differed very considerably in the amounts of rot and of net necrosis present, both of which were most severe in the material from the Davis farm and were almost equally bad on the lots with and without boron In the potatoes from the other three farms, those from the plots receiving no boron in all cases had somewhat less rot than those from the boron-treated plots, and in two of the three they also had less net necrosis. The differences are small and have little significance further than that they indicate that boron had no effect in reducing the occurrence of net necrosis

The losses in peeling for the various lots of the two varieties that were dehydrated in December ranged from 11.6 to 19 4 per cent, averaging 15.7 for all lots of Katahdin and 15.6 for those of Green Mountain. The losses in trimming ranged from 2.9 to 10 1 per cent, averaging 3 9 per cent in Katahdin and 7.1 per cent in Green Mountain. There were no indications that peeling and trimming losses were affected by the fertilizer treatments, as the differences between pairs of samples receiving the two treatments from the various farms were not consistent and are attributable to differences in average size, in smoothness of tubers, and in percentage of small tubers present in the various lots. The absence of any difference in effect of the two treatments is evident when the yields of prepared strips for the two treatments are averaged separately These averages were for Katahdin, 80 8 per cent for the non-boron lots and 79.9 for those with boron; for Green Mountain, 77.4 per cent for non-boron and 77.2 for those with boron It may be noted that the over-all yields of prepared strips

were 80 3 per cent for Katahdin and 77.3 per cent for Green Mountain.

In the material dehydrated in February after storage for 2 or 2½ months at 60° F., the losses in peeling were slightly higher, averaging 18 4 per cent for each of the varieties. The increase in losses over those of the material prepared in December was due chiefly to increased resistance to the action of lye, requiring slightly longer treatment, and to the presence in some lots of varying numbers of sprouts that were removed in peeling The trimming losses for Katahdin were very slightly higher than those for Katahdin in December—4 3 per cent instead of 3.9—, whereas in Green Mountain they had increased from 7.1 to 10 7 per cent as a consequence of the presence of varying amounts of net necrosis. The yield of prepared strips for all lots of Katahdin was 77.2 per cent and for Green Mountain, 70 8 per cent Since peeling losses in the two varieties were identical in amount, the low yield of prepared strips in Green Mountain was due to the heavy trimming made necessary by the presence of net necrosis As had been the case in the material dehydrated in December, there was no tendency for the boron-treated samples to run consistently higher or lower than the untreated checks in yields of prepared strips.

In the last two columns of the table, the yields of dry product are given as percentages of the fresh whole stock prior to preparation and also as percentages of the prepared strips The yields as percentages of whole stock vary inversely as the losses in peeling and trimming, and hence show no consistent differences between the two treatments. The yields calculated as percentages of the weight of prepared strips are of course not affected by the losses in preparation, hence should indicate differences in solids content of the potatoes attributable to the differences in fertilizer treatments, if such differences existed. In the first dehydration of Katahdin, the average yield of the four lots receiving no boron was 18 6 per cent of the weight of prepared strips; that of the boron-treated lots 18.5 per cent. The yields from dehydration after storage were, with no boron, 18 1 and with boron, 19 8 per cent. In the case of Green Mountain, the yields at the first dehydration were with no boron, 20.5 per cent; and with boron, 20 1; and those at dehydration after storage were 21 8 and 21.9 per cent, respectively The differences between the two treatments are smaller than those between lots receiving identical treatment but grown on different farms, making it clearly apparent that there were no differing effects of the two treatments on solids content.

Results of the examination of the data upon the occurrence of rot and net necrosis, peeling and trimming losses, and yields of dry product can be summarized by the general statement that the material receiving boron in the fertilizer showed no consistent or significant differences in any of these respects from that receiving no boron. This statement appears to hold for the results as a whole and also in detail for the material produced on individual farms.

The various lots of dry material were examined and compared during the drying, and as it was completed, for any differences in color or appearance that might be apparent between the varieties, the fertilizer treatments, or the potatoes from the different locations No consistent differences attributable to location or fertilizer were found

Examination and Grading of the Dry Products

Preparation and grading of the material for appearance and quality as cooked products were carried out from the 29th to the 31st of March, 1945. As there were two varieties receiving two fertilizer treatments in each of four locations, there were sixteen lots of material As a portion of each of these was dried shortly after its receipt and the remainder after 8 to 10 weeks in storage at 60° F and each lot was subdivided into three portions receiving different preparatory treatments before drying, the number of samples to be judged was ninety-six.

The samples were inspected and graded for color in the dry condition by matching the predominating color of each sample as closely as possible with the Maerz and Paul colors (8) Since there was frequently considerable variation in color among the pieces making up the sample and even between different portions of individual strips, matching was approximate rather than exact The predominating color of the samples also varied considerably as a result of varying amounts of reddening, graying, or darkening, with the result that the colors found in the different samples ranged from 9 C 1 of the Maerz and Paul system through plates 10 and 11, with a few samples as dark as 12 D 2 and 12 E 2. The entire series was then graded numerically. Samples that had undergone no perceptible discoloration during or subsequent to drying and closely approximating 9 D 1 in color throughout were graded 1, those showing darkening, reddening, or graying were given lower numerical ratings, ranging fom 1 5 or 2 to 8, according to the degree of discoloration.

The material was refreshed by weighing out samples of 75 grams

into beakers, covering each sample with 225 milliliters of water and placing in a refrigerator overnight. The beakers were then set into a retort, covered so no evaporation could occur, and cooked in flowing steam for 40 minutes They were then removed, placed on plates, given code numbers, and submitted to the judges No salt or other seasoning was added, because such additions would have tended to mask differences in flavor.

Each of the cooked samples was graded upon the factors of color, texture or consistency, and flavor In the grading, a scale of 10 was employed in which a score of 1 to 1 9 indicated high or excellent quality; 2 to 3.5, very good to good; 3 6 to 4.9, fair or acceptable; and scores numerically higher than 5, poor to very poor After the scoring on the separate factors had been completed, each sample was given an over-all score on comparative desirability or acceptability The scores of the various judges were then assembled and averaged

As stated in the section on preparation of material, all potatoes were placed in a 1-per cent salt solution after peeling, and the strips were received into such a solution as they were cut and until they could be blanched One complete series of samples was dehydrated without any treatment designed to prevent discoloration, whereas two such series received preventive treatment, one with orthophosphoric acid and the other with sulfurous acid solution The comparative effectiveness of these treatments will receive some attention in a subsequent section The primary purpose of the work was to determine any differences in the tendency to discoloration between the potatoes receiving boron in the fertilizer and those receiving none, and the presence of such differences, if they exist, would be evident in the samples receiving no treatment other than holding in salt solution between time of peeling and blanching. The results of examination and grading of this series are assembled in table 2

The material of each variety is represented by four sets of samples from as many different farms, each set consisting of two pairs of samples Each pair was made up of boron-treated material and a check receiving no boron One of the pairs of samples in each set of four had been dehydrated shortly after receipt of the material at the laboratory, and the dry products had consequently been stored in air at 70° F for 3½ months prior to examination The potatoes from which the second pair was made had been stored at 60° for 8 to 10 weeks before being dehydrated, so that the dry samples had been stored in air at 70° for 6 weeks before being examined

TABLE 2.—*Scores on color in dry condition and on color, flavor, texture and general desirability in cooked condition of dehydrated products made from Katahdin and Green Mountain potatoes grown in four locations with and without addition of boron to the fertilizer applied, with averages for all samples for each variety under each treatment.*

Variety	Grower	Fertilizer Treatment	Date Dehydrated	Color Grade in Dry Condition	Ratings of Cooked Material: Color	Flavor	Texture	General Desirability
Katahdin	Brogdon	No Boron	12- 1-44	6.0	4.6	3.5	3.4	3.5
		Boron	12- 1-44	4.0	3.2	2.7	2.7	3.2
		No Boron	2-17-45	2.0	2.0	2.1	2.2	2.2
		Boron	2-17-45	2.0	1.6	2.4	2.1	2.2
	Coates	No Boron	12- 1-44	5.0	3.6	3.1	2.5	3.5
		Boron	12- 1-44	7.0	5.0	3.6	3.5	4.2
		No Boron	2-17-45	1.0	3.0	3.5	2.8	3.4
		Boron	2-17-45	1.3	3.2	2.8	2.5	2.9
	Davis	No Boron	12- 1-44	6.0	4.5	3.1	3.2	4.0
		Boron	12- 1-44	6.0	3.7	3.0	3.5	3.8
		No Boron	2-19-45	1.0	1.5	2.2	2.5	2.0
		Boron	2-19-45	1.5	1.5	1.9	2.7	2.0
	Hewitt	No Boron	12- 1-44	4.5	3.2	3.6	3.1	3.3
		Boron	12- 1-44	6.0	4.1	3.5	2.5	3.8
		No Boron	2-19-45	1.0	1.5	2.6	2.4	2.4
		Boron	2-19-45	1.6	2.6	2.4	2.7	2.6
Green Mountain	Brogdon	No Boron	12-18-44	3.5	3.0	3.1	1.7	2.8
		Boron	12-18-44	1.8	3.7	4.1	3.7	4.1
		No Boron	2-16-45	2.0	2.3	2.8	1.5	2.7
		Boron	2-16-45	1.5	1.8	2.5	2.2	2.3
	Coates	No Boron	12-18-44	3.0	3.9	3.2	3.0	3.7
		Boron	12-18-44	3.0	3.5	2.8	2.1	3.2
		No Boron	2-17-45	3.5	2.3	3.5	2.2	3.5
		Boron	2-17-45	2.0	2.8	2.8	2.1	2.8
	Davis	No Boron	12-18-44	4.0	4.2	3.0	2.7	4.2
		Boron	12-18-44	5.0	4.1	3.4	2.2	4.1
		No Boron	2-16-45	2.5	2.4	2.2	1.6	2.0
		Boron	2-16-45	1.5	2.5	3.5	2.5	3.0
	Hewitt	No Boron	12-18-44	8.0	7.0	4.7	2.7	6.0
		Boron	12-18-44	2.0	4.8	3.0	2.3	3.3
		No Boron	2-16-45	2.0	2.0	1.7	1.9	1.9
		Boron	2-16-45	2.0	2.0	3.5	2.4	3.2
Averages of All Samples								
Katahdin	Dehydrated 12/1/44	No Boron		5.4	4	3.3	3.0	3.8
		Boron		5.7	4	3.2	3.0	3.7
	Dehydrated 2/17-19/45	No Boron		1.2	2	2.8	2.5	2.5
		Boron		1.6	2.2	2.4	2.5	2.4
Green Mountain	Dehydrated 12/18/45	No Boron		4.6	4.5	3.5	2.5	4.2
		Boron		3.0	4.1	3.3	2.6	3.7
	Dehydrated 2/16-17/45	No Boron		2.5	2.2	2.5	1.8	2.5
		Boron		1.8	2.3	3.1	2.3	2.8

When the material was removed from storage for examination and grading it was apparent that the lots made in December, which had consequently been stored for 3½ to 4 months, had undergone varying amounts of darkening or reddening and were distinctly poorer in color than when first made As previously stated, the various lots of material were examined and compared as drying was completed in order to detect any differences between them attributable to fertilizer treatment or location of growth. The material dehydrated in February was given a like examination as drying was completed. Even though no comparisons with the Maerz and Paul color standards were made on the freshly dried material at either drying date, the products made at the first drying were considered to be good to very good, in color At the time the second drying was completed the products were regarded as being generally slightly less good in color than the freshly made material from the earlier drying. Whether this were the case or not, there were clearly no such differences between the two lots of material when made as were apparent at the end of the storage period. In the material made in December, many lots were poor to very poor and unacceptable in color in the dry condition.

Inspection of the data in table 2 will show that the ratings of the samples made in December are with very few exceptions lower on all factors considered than those of the corresponding samples made in February The differences in color in dry and cooked are largest and most consistent, those in flavor are somewhat smaller and less consistent, and those in texture small, not constantly present, and doubtfully significant The ratings for all samples of each variety for the two fertilizer treatments and for the two drying dates have been averaged and the results included in table 2. They emphasize the differences in quality between the products made at the two drying dates, those made in February ranking collectively as very good; those in December as fair The data warrant the conclusion that storage of the dried product in air at 70° F. for 3½ to 4 months had resulted in very considerable deterioration in color, flavor, and general desirability of all the material, regardless of variety, place of growth, or fertilizer treatment Some change had doubtless occurred in the material made and stored in February, but it had not gone far enough to be apparent.

Comparison of the general averages for all samples receiving boron with those receiving none shows no significant differences attributable to fertilizer treatment in either variety or at either drying date

In Katahdin dried in February, color was slightly poorer and flavor slightly better in the series receiving boron In Green Mountain, dried at the same time, the exact opposite is the case In neither variety do the series dried in December show the differences between boron and no-boron found in those dried in February. This compels the conclusion that the boron treatments had no effects upon color or flavor that were consistent and significant for all the material regardless of place of growth or treatment prior to drying

The question whether application of boron might have had an effect upon one variety that did not occur in the other can be answered by comparison of the data of table 2 The general averages for Green Mountain show that the color of the dry products for both early and later dryings, was considerably better in the boron-treated material and in the early dried series this was also true for the cooked material In the Katahdin material the boron-treated samples from only one of the four locations were better in color than those from the no-boron checks. In the material from the other locations, any differences in color between boron-treated samples and checks were generally in favor of the checks This would seem to indicate that boron might have had some general effect upon the tendency to discolor in Green Mountain regardless of the location and soil but did not have any such general effect upon Katahdin Since the material was grown in four different locations, there were presumably differences in character and composition of the soils and in the amount of boron already present, such that the effect of the added boron may have varied from farm to farm. If it were definitely beneficial or injurious in any given location, all the boron-treated samples from that location should be consistently better or poorer in color than the checks receiving no boron. Inspection of the data for the Coates, Davis, and Hewitt farms shows no such consistent difference Of the four pairs of samples at each of the three locations, one of the boron-treated lots in each case was better in color and two were poorer than the corresponding non-boron lots, the remaining pair of samples showing no difference. In the case of the Brogdon farm, there are indications that the application of boron may have had some beneficial effect in reducing the tendency to discoloration in Katahdin as well as in Green Mountain In the four pairs of samples, color in the dry condition was best in the boron-treated sample in three pairs and best after cooking in the remaining pair. This indicates a possibility that the added boron was of benefit to both varieties upon this particular soil.

It is unfortunate that the experiment did not include a series of

plots to which boron was applied in various amounts, both larger and smaller than that here used. It is definitely established that boron in small amounts is beneficial and stimulatory but that larger concentrations are injurious The inconclusive results of this experiment make it appear probable that for these particular soils, the amount of boron added brought the total present above the range in which beneficial effects are evident with potatoes, yet did not raise it high enough to produce definite injury More comprehensive experiments employing a closely graded series of applications, from a mere trace to amounts known to be very definitely toxic or lethal, and involving continuous observation of the plants throughout the season as well as detailed study of the mature tubers, will be necessary to determine the degree to which the quality of the tubers can be affected by application of boron.

Comparative Effectiveness of Preparatory Treatments in Preventing Discoloration

The study of this material afforded opportunity to obtain data upon the comparative effectiveness of orthophosphoric acid and sulfurous acid dips in preventing discoloration of potatoes in drying and deterioration in color and palatability in subsequent storage In addition to the series of samples prepared without other treatment than holding in dilute salt solution after peeling, two series were prepared, one immersed for 4 minutes in 0.1-per cent orthophosphoric acid and the other for a like time in 0 1-per cent solution of SO_2 gas in water prior to drying Comparisons between the three series of samples in the dry state and after cooking showed that the material dried without treatment other than holding in sodium chloride solution before blanching had darkened very little during drying but had subsequently undergone very considerable and general darkening during storage Treatment with orthophosphoric acid had been fairly effective in preventing discoloration in drying and in storage but the material treated with it underwent considerable discoloration during refreshing and cooking Dipping into sulfurous acid solution had effectively prevented any change in color throughout drying, storage, and cooking There were no consistent or significant differences in texture as a result of the different treatments Flavor in the orthophosphoric acid series was consistently slightly inferior to that of corresponding members of the salt-dipped series and rather markedly so in the case of the samples that had been in storage for the longest time Many of the samples of

the series dipped in sulfurous acid and particularly those that had been most recently made retained sufficient SO_2 after cooking to be objectionably evident to taste, and the ratings on flavor were consequently not comparable with those of the other series

Summary

Potatoes of the varieties Katahdin and Green Mountain, which had been grown in four locations in Maine under two fertilizer treatments, one containing boron at the rate of 7½ pounds per acre and the other containing none, were shipped to Beltsville, Maryland. A portion of each lot was dehydrated soon after receipt of the shipment in December, and the remainder was dehydrated after storage at 60° F. until mid-February.

No consistent differences between boron-treated lots and checks in respect to size, surface cracking, decay, stem-end browning, darkening of the vascular ring, net necrosis, or other defects could be seen in the raw stock, and there were also no consistent differences between them in amounts of losses in peeling and trimming, in tendency to discolor during preparation and drying, in appearance of the freshly dehydrated product, or in solids content and yields of dry product

The products made at the first drying period were stored in air at 70° F. for 10 to 14 weeks, and those made at the second drying period were stored at the same temperature for 6 weeks prior to examination, cooking, and scoring. All the material stored at 70° F. for the longer storage period, regardless of fertilizer treatment or location in which it was grown, had undergone varying amounts of darkening or reddening during storage and was distinctly inferior in appearance as dry products to the material made later, hence stored for a shorter time When the material was cooked, the older samples were very generally poorer in color and flavor than those more recently made. The lots made in February were rated as very good and those made in December as fair.

There were no consistent differences in color and flavor between lots of Katahdin from plots receiving boron and those receiving none In Green Mountain the color of the dry products was on the average considerably better in the boron-treated lots than in the checks, but in most cases the differences largely disappeared when the material was cooked

Insofar as could be determined from study of the fresh tubers and their dehydrated products, there was no evidence of any injurious

effects to either variety resultıng from the application of boron to any of the four soıls. For three of the soils there was also no evidence that its applicatıon was beneficial to Katahdin. On the fourth soıl, discoloration in Katahdin, as well as ın Green Mountain, was less in the samples receıving boron, indıcating some benefıt to both. It appears probable that foı the soıls used the amount of boron applied was below that necessary to produce definite injury but resulted in a total above what would induce consistent and unmistakable improvement over plants receıvıng none.

In a serıes of samples dıpped ın orthophosphoric acid or sulfurous acıd solution prior to dryıng, dıscoloration during dryıng, subsequent storage, and cookıng was entirely prevented by sulfurous acid. It was prevented durıng dryıng and reduced in amount during storage by orthophosphoric acid, but samples so treated underwent consıderable darkening in the final cookıng

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RESISTANCE OF POTATO TO VIRUS Y, THE CAUSE OF VEINBANDING MOSAIC

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Potato mosaic virus Y is the cause of veinbanding mosaic, one of the three major potato mosaic diseases. It occurs in the leading potato regions in America as well as in foreign countries In many varieties it is responsible for greater reduction in yield than that caused by the other two mosaic viruses, A and X In Green Mountain and similarly susceptible varieties, virus Y causes at least a 50 per cent reduction in yield whereas viruses A and X are each responsible for 15 to 30 per cent losses (1, 3, 5, 13, 14).

Virus Y causes a variety of symptoms in different varieties, ranging from light green and faint mottling to severe necrosis, curling, and dwarfing of the plants (8, 9, 10, 11, 12, 15) Virus Y in combination with virus X produces rugose mosaic, a more severe reaction on many varieties than that produced by a single virus.

Virus Y is easily transmitted by leaf rubbing and grafting as well as by means of the potato aphid (8, 9, 10, 15).

Tobacco, tomato, and certain other plants of the nightshade family are susceptible to virus Y.

Virus Y can be isolated and differentiated from viruses A and X by means of potato varieties that are susceptible to virus Y but immune from viruses A and X (11, 12, 13). Likewise some other nightshade plants, like Jimson weed, *Datura stramonium*, that are immune from virus Y but susceptible to virus X can be used as differential hosts. Furthermore, virus Y differs from virus A and X in filterability, ageing, dilution, and thermal inactivation (15).

Since disease-resistant plants are the most effective means of disease control, studies to determine the reaction of different potato varieties to virus Y were initiated several years ago. The results of these resistance tests are recorded in the following pages.

METHODS OF TESTING

To favor infection by means of aphids, potatoes were planted in hills that alternated with hills of a variety harboring virus Y. Each va-

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riety was represented by 10 to 20 hills. The Green Mountain variety served as a susceptible control. To supplement natural aphid infestation in the field viruliferous aphids of the species *Myzus persicae,* previously cultured on a virus-Y-harboring variety under cloth cages, were introduced into the test plots by depositing infested leaflets in the tops of all the plants. About four weeks before harvest the virus-Y-harboring tops in the field were cut off to induce aphid dispersal to the varieties under test.

At harvest, one tuber per hill was reserved for planting in the following season for readings on virus Y infection Varieties that did not contract infection in the field test were subsequently exposed under cloth cages under heavy aphid infestation to test for immunity from virus Y.

The virus Y resistance tests were conducted on Aroostook Farm, Presque Isle, Maine, from 1937 to 1944.

As recorded in table 1, 720 potato seedling varieties representing five crosses and two selfed varieties were interplanted in the field with the virus-Y-harboring variety 42898, a late variety that carries the virus without conspicuous symptoms Earlaine, Chippewa, Irish Cobbler, Katahdin, and 24642 are immune from virus A under field conditions and the variety 41956 is immune from virus X (11, 12) Furthermore, Katahdin and 24642 contract leaf roll less easily in the field than Green Mountain and other similarly susceptible varieties Katahdin also shows some resistance to virus X The various parent varieties were planted as controls and the Green Mountain served as the virus-Y-susceptible control. The potato seedling varieties and the parent controls were exposed during 1 to 6 consecutive seasons The Green Mountain control contracted virus Y in every hill in one season and so virus Y free Green Mountain seed potatoes were introduced each year. Thirty-nine Katahdin selfed varieties that did not contract virus Y in two seasons in the field were exposed in cloth cages under heavy aphid (*Myzus persicae*) infestation to test for virus Y immunity.

The results from the exposure tests recorded in table 1 disclose that the virus-Y-susceptible Green Mountain control contracted virus Y in almost every hill whereas some seedling potato varieties from every cross or selfed variety did not become infected Many of the infected seedling varieties contracted virus Y in only one or two hills of the 20 hills, which indicates that such varieties were less easily infected than the Green Mountain control or similarly susceptible varieties. Chippewa, Earlaine, Katahdin, and 24642 contracted virus Y less generally than did Green Mountain Chippewa became infected less easily than the other varieties.

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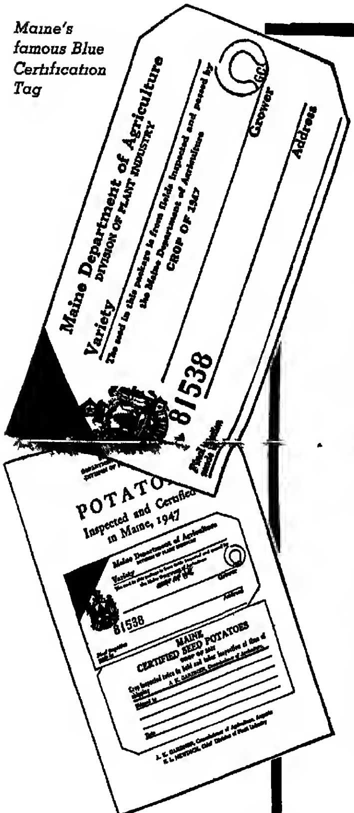

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TABLE I.—*Resistance to virus Y of potato seedling varieties that were interplanted with Y seedling variety No 42898. Aroostook Farm, Presque Isle, Maine, 1937 to 1942*

Pedigree Number and Parentage	Seedling Varieties	Years Exposed	Exposure	Varieties Infected with Virus Y	Range in No of Virus Y Hills for Infected Varieties
	Number			Per cent	Number
1241					
Katahdin selfed	102	1937-42	Field	93	1-20
Katahdin	10[1]	do	do	100	9-16
Green Mountain	9[1]	1 year	do	100	19-20
1241					
Katahdin selfed	39[2]	1939	Cages	90	
Katahdin	12 hills	1939	do	100	
Green Mountain	12 hills	1939	do	100	
1028					
Katahdin selfed	86	1939-42	Field	87	1-20
Katahdin	9[1]	1939-42	do	100	5-12
Green Mountain	6[1]	1 year	do	100	18-20
926					
Katahdin x Earl	92	1939-42	do	90	1-18
Katahdin	7[1]	1939-42	do	100	1-7
Earlaine	7[1]	1939-42	do	100	1-7
Green Mountain	7[1]	1 year	do	100	17-20
455					
Chippewa x 24642	110	1939-42	do	85	1-20
Chippewa	11[1]	1939-42	do	9	1
24642	11[1]	1939-42	do	72	1-5
Green Mountain	10[1]	1 year	do	100	18-20
537 & 937					
41956 x Katahdin	44	1940-42	do	80	1-18
Green Mountain	4[1]	1 year	do	100	18-20
X336					
President x Kat	90	1940-42	do	97	1-20
Katahdin	4[1]	1940-42	do	100	5-10
President	4[1]	1940-42	do	100	13-18
Green Mountain	9[1]	1 year	do	100	19-20
BI 1012					
Chippewa selfed	94	1942	do	59	1-19
Green Mountain	5[1]	1942	do	100	20
X203					
Irish Cob x Kat	102[3]	1940-42	do	91	

[1]Number of 20-hill replicates that served as controls.
[2]Varieties that did not contract virus Y in field in 1937.
[3]Dosed with *Myzus persicae* raised on virus-Y-harboring leaves of 42898 in 1940.

The parents and their progeny that contracted virus Y manifested a variety of symptoms ranging from light green, slightly rugose leaves to necrotic, curled, and severely dwarfed plants.

Among the progenies, 3 to 41 per cent of the seedling varieties did not contract infection. These are not necessarily virus Y immune but are highly field resistant. Some varieties that did not contract virus Y in the field became infected under more severe exposure to heavy aphid dosage under cloth cages Even under this severe exposure a few varieties resisted more than one exposure before they became infected.

TABLE 2.—*Resistance to Virus Y of potato seedling varieties that were exposed to Virus-Y-harboring seedling variety No. 42898. Aroostook Farm, Presque Isle, Maine, 1943 and 1944.*

Pedigree Number and Parentage	Varieties	Years Exposed	Varieties Infected with Virus Y	Virus Y Infected	Hills for Varieties
	Number		Per cent	Number	Per cent
B 1043		1943			
Chippewa selfed	93	1944	65	1—8	28
Green Mountain	7[1]	1944	100	10	100
B 205		1943			
Katahdin x 792-94	99	1944	91	1—10	52
Green Mountain	3[1]	1944	100	10	100
B 1052		1943			
792-94 selfed	46	1944	85	1—10	57
Green Mountain	1[1]	1944	100	10	100
B 208		1943			
1241-66 x 792-94	12	1944	83	1—6	28
Green Mountain	1[1]	1944	100	10	100
B 209		1943			
1241-62 x 792-94	14	1944	71	1—10	62
Green Mountain	1[1]	1944	100	10	100
8 210		1943			
792-133 x 1241-84	7	1944	57	1—10	35
Green Mountain	1[1]	1944	100	10	100
BI 1012		1944			
Chippewa selfed	35[2]	in cages	40	1—2 in 6 hills	30
Chippewa	14	do	43		
Katahdin	15	do	100		
B 1043		1945 & 1946			
Chippewa selfed	50[3]	in cages	46		

[1]Number of 10-hill replicates that served as controls.
[2]Varieties that did not contract virus Y in the field in 1942 and 1943
[3]Vareties that did not contract virus Y in the field in 1944.

In table 2 are recorded the results obtained from 271 potato seedling varieties, the progenies from four crosses and two selfed parents that were exposed to virus Y in the field for two seasons. Five parents, Chippewa, Katahdin, 1241-62, 1241-66, and 1241-84, are resistant to virus Y; and two parents, 792-94 and 792-133, are immune from viruses A and X (virus A is the aphid-transmitted component of mild mosaic and virus X is the cause of latent mosaic which is generally harbored by many commercial varieties). Fifty varieties from Chippewa selfed that did not contract virus Y in the field during two seasons were exposed under cloth cages to heavy aphid infestation.

As recorded in table 2, every hill of the Green Mountain controls became infected with virus Y. Though 57 to 91 per cent of the seedling varieties in the various progenies contracted virus Y, many of these varieties became infected less generally than did Green Mountain, whereas other varieties reacted like Green Mountain The progeny of selfed Chippewa apparently resisted infection more than the progenies from the other parents. Some varieties that did not contract virus Y in the field became infected under heavy aphid infestation in cages.

Most of the infected varieties manifested necrotic and curled foliage whereas others developed only light green and rugose leaves.

Observations on the reaction of different potato varieties to virus Y show that some varieties are highly resistant, others readily contract infection, and many are moderately resistant, or intermediate between the highly resistant and least resistant groups.

Resistance apparently is not necessarily correlated with symptom expression, since some of the most resistant varieties manifest severe necrosis, curling, and dwarfing like that manifested by the least resistant varieties Local necrotic lesions obtained by artificial inoculation have been reported to indicate virus Y resistance that is inherited from such necrotic parents (4, 6, 7).

Resistance to infection appears to be influenced by aphid dosage. Varieties that rarely contract virus Y in the field become generally infected when heavily infested with viruliferous aphids under cloth cages, as well as with heavy aphid dosage in the open field. This experience indicates the importance of developing varieties that are immune from virus Y. Field exposure that favors 100 per cent infection with virus Y on a susceptible control also favors 100 per cent infection of equally susceptible seedling varieties, but it does not necessarily disclose all of the less susceptible varieties in a single exposure test. Planting several replicates of a variety would be likely to reveal susceptibility in a shorter time than when a single replicate is used.

Seedling variety 24642, one of the parents of Chippewa and Katah-

din, contracted virus Y less generally than did Green Mountain. Also some of the progeny of 24642, Chippewa, and Katahdin are more resistant than the parents (2, 9, 6, 7).

A few varieties have not contracted infection although exposed to virus Y for several seasons. Additional infection tests with these varieties are in progress to determine whether they are immune from virus Y or merely escaped infection.

Summary

Veinbanding mosaic caused by virus Y is one of the three major mosaic diseases of potato. It occurs in the leading potato regions where it is capable of causing more than 50 per cent reduction in yield of susceptible varieties when it is widely spread by aphids. The leading commercial varieties are susceptible to veinbanding mosaic.

In combination with other viruses virus Y causes more severe injury than when it occurs alone. Since most of the commercial varieties harbor latent mosaic virus, such varieties on becoming infected with veinbanding mosaic manifest the severe reaction known as rugose mosaic.

Veinbanding mosaic is characterized by various symptoms ranging from slightly light green, mottled, and rugose leaves, to severely necrotic, curled, and dwarfed plants The degree of these symptoms is influenced by the variety.

Studies on resistance of different potato varieties to virus Y show that varieties may be grouped as: 1, highly resistant, rarely contracting more than a trace of infection in the field; 2, moderately resistant, contracting 10 to 20 per cent of infection by plant count; 3, slightly resistant, contracting higher percentages of infection up to approximately 100 per cent; and 4, non-resistant, contracting practically 100 per cent of infection

Resistance to infection by virus Y is affected by aphid dosage Varieties seemingly resistant in the field are not necessarily resistant under heavy aphid infestation in cloth cages.

Virus Y resistance is heritable. A greater number of resistant seedlings are produced from highly resistant parents than from non-resistant parents. The progeny from resistant parents may be more resistant to virus Y than the parents.

Unless aphid vectors of virus Y are abundant, not all of the susceptible varieties are necessarily infected in a single season's exposure test.

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SECTIONAL NOTES

Colorado

As a result of the labor shortage, together with adverse weather conditions, some of the harvesting in Colorado continued well into the month of November However, there was only a negligible acreage frozen in the ground The market has been quite active with the shipments of Red McClures running ahead of the same dates last year. About one-half of the Red McClure crop has already been shipped. Eighty-four per cent of these shipments have been U. S No. 1 and 35 per cent have been washed.

Colorado will have about the same amount of seed potatoes this year as last. Although the acreage entered for certification was less

than in 1946, the rejections were considerably less with the result that about the same acreage passed the final inspection. There may be a definite seed shortage next spring. The prevailing market prices have caused a few growers to sell their certified seed as table stock. Should any large amount of certified seed be sold as table stock, the supply will be very short next spring. Inquiries for certified seed have increased within the last month so this danger may be largely eliminated. However, the early areas which are normally heavy purchasers of certified seed sold a large part of their crop in July and August at Government support prices. These low returns for the early crop are not inducive to large investment for the next crop (Dec. 3).—CECIL W. FRUTCHEY.

FLORIDA

The planting season in the Homestead section is very late because of flood conditions in farm lands resulting from the excessive rainfall during October Soil conditions are slowly improving but much of the land is still too wet for working and it may be the 15th of January before planting is completed.

Growers had planned to plant about 6,000 acres this year. Approximately 60 per cent of this was planted by the 1st of December with prospects for a poor stand in many fields. There was considerable seedpiece decay in the early plantings, which made it necessary to replant many fields, and this may reduce the final acreage to less than 5,500

Approximately 55 per cent of the acreage will be planted to Pontiacs with Bliss Triumph accounting for practically all of the remainder. A few Sebagos are being planted.

Late blight has not as yet appeared on potatoes It has, however, been found on some lots of potato seed shipped into the area, and has been reported in tomato seedbeds. This report has not been confirmed by personal observation. (Dec 2).—GEO. D. RUEHLE.

KENTUCKY

Killing frost came on the 4th of November, fully three weeks behind schedule. By that time, Irish Cobbler vines had been dead several weeks. Because of a dry season, the Cobblers yielded only 125 bushels per acre, but the quality and seed-size were good. A total of eleven acres was certified.

In contrast, frost found Sequoia's vines still green, this variety being capable of withstanding dry weather and then resuming growth. The yield was 240 bushels per acre; the quality is excellent but many over-size tubers need to be culled for certifying. Fifteen acres were

certified. It is the growing belief among Jefferson county's potato men that Sequoia may well be grown for winter tablestock use, as it has consistently yielded more than 225 bushels per acre, for the past four years.

Sebago, of which one acre was certified, suffered because of dry weather, therefore the vines died early, making only 125 bushels per acre. We are not sure that Sebago is for Kentucky, but its brightness and general attractiveness are intriguing. (Dec. 12).—JOHN S. GARDNER.

MAINE

The potato market right now is in the doldrums. The Government stopped their purchasing program the last of November. The increased price support for December has resulted in practically no market. The Government had purchased about 2500 cars, most of which have gone into storage. It is expected that they will start purchasing again within a few days for the Government realizes that practically every farmer in Maine is entitled to price support. Contract dealers cannot operate under the low price for they have agreed to pay the farmer at least support prices. This makes a serious situation. Most folks agree that if the Government comes back into the picture the market should be strengthened.

The Extension Service, State Department and Shippers Committee are receiving the backing of the industry in a new seed program. The idea is to get every farmer in the state to plant only Certified Blue Tag seed. They have adopted a slogan:

"If you are shooting
For highset yields
Use Blue Tag Certified
On all your fields"

The object is to eradicate ring rot and if all seed can be replaced by certified seed outstanding progress should be made in eradicating the disease. The tax committee has voted approximately $2,000.00 to be expended on posters and stickers. One of the big production problems this year with many growers is frosted ends with the Katahdin variety. This is especially true in the northern section of the County. Farmers are still having trouble keeping Katahdin under ground. Many times they either sunburn or are touched by frost because they set so near the surface. A campaign will be forwarded next year to induce farmers to hill Katahdins very late in the season so that they will be deep enough to avoid sunburn and frosted ends.

Maine, of course, has what is generally known as a "high ridge" although Aroostook folks term it a "medium ridge hill".

P M.A. is holding election meetings in 28 Aroostook communities. A discussion of a long term program for the potato industry will be led by a few industry leaders. It is expected that the subject of marketing agreements will be proposed. An expression will be secured at the meeting to learn if farmers are interested enough to request that a proposed marketing agreement be brought up for consideration

Certified seed growers are feeling optimistic. We expect to ship one of the finest crops ever grown. Our virus diseases are thought to be extremely low and the general appearance is very good. The weather during harvesting was good so most of our potatoes are bright and clean. (Dec. 5).—VERNE C. BEVERLY

NEBRASKA

The movement of potatoes, seed or table, in Nebraska is considerably behind schedule for this time of year. Although the estimate of production has been reduced 25 to 30 per cent as compared with a year ago, shipments to date, are lower than that proportionately. One of the chief factors retarding shipments, has been the reluctance of growers to sell at current prices being offered by shippers. Shippers, in turn, contend that they are unable to pay higher prices for potatoes because of outside market resistance. Many people seem to feel that there will be more potatoes offered after the first of the year, on the theory that some of the reluctance of farmers to sell is due to the high income bracket in which they already find themselves. Without a doubt, this has some bearing on the situation.

Certified seed potatoes have been moving to the lower Rio Grande valley of Texas for more than a month, and such shipments will probably be completed very soon Other territories will not begin taking their seed until early January. This includes Louisiana, Alabama, Mississippi and Florida.

Test samples of all certified seed lots grown in Nebraska and Wyoming have been shipped to Los Fresnos, Texas for planting on the 15th of December Readings of the test plot during February, will give a preview of the quality and disease freedom of seed to be planted for certification in 1948 Lots found to contain too much disease must be replaced with better stock that will qualify as foundation seed, in order to be eligible for certification (Dec. 5).—MARX KOEHNKE.

New Jersey

Potato growers in New Jersey have placed very few potatoes in storage and have therefore made very few carlot shipments during the winter months. They have been busy repairing and remodelling buildings, reconditioning machinery, and also plowing in preparation for next year's crop.

Many rumors continue to be circulated among the growers in connection with the reduction in potato acreage goals to be recommended for New Jersey by the Department of Agriculture in 1948.

To date no definite figure has been released by P.M.A. and growers are still wondering if the reduction will be 15-20 or 40 per cent. These figures have been rumored wherever potato growers gather. Latest indications point to a return to the original direction that no reduction in acreage will be requested. If this is so the government is probably assuming that there will be foreign demand for our potatoes again next year, that yields will likely be lower or that a large supply will discourage high prices. There may also be a possible change in the method used to determine parity which will result in lower prices to the consumer We should know definitely what the goals will be as soon as reports are released from the meeting at Colorado Springs. (Dec. 12) —John C. Campbell.

New York

Reports from several sources indicate that some potatoes are not coming out of storage as well as expected. A hot period following a period of low temperatures which produced some field frost seems to be the cause. The size and quality are reported good otherwise.

More than 90 per cent of Central New York potatoes are going to market in consumer packages. The demand seems to equal or exceed the supplies at times and growers who are in the program are making money

Some growers are worried about the 1948 crop and the effect of cessation of support on December 31. Being late potato producers with storage facilities they are concerned about prices, should the crop be large. This feeling will probably reduce the acreage and it is hoped that the situation will take care of itself.

The quantity of available certified seed is lighter than usual and growers are holding for a strong spring market Fall sales were at a minimum because of the shortage of storage (Dec 4) —H J. Evans

Oregon

Our growers have indicated that they expect to plant more potatoes than in 1947. The quantity of high quality certified Russet seed available may have been an important factor. Shipments of our 1947 crop to date are approximately 60 per cent that of 1946 Our seasonal shipments are generally estimated at about this rate, possibly a few per cent higher.

Our growers generally speaking, are in favor of a limited acreage and some type of support. This area is under marketing agreement that has not yet been used. We believe this form of maintaining prices would be satisfactory if undergrades could be withheld from the market during years of surplus It is also our opinion that a support level insuring regular potato growers cost of production plus a reasonable profit be adopted The diversion of potatoes for processing and livestock feeding is believed to be very helpful. Our growers are still attempting to establish a processing plant for starch manufacture The large plant we now have has operated in a small way but is at present closed because of financial difficulties. (Nov. 25). —C. A. Henderson.

Washington

There were 1,111.8 acres of potatoes certified in Washington during the past season of which 895.5 acres were White Rose Our estimated total yield of certified seed was 394,941 bushels For several years our total number of certified acres has declined. However, the quality of the seed stock has improved. This is indicated by the results of this year's field inspections when only 24 acres were disqualified for virus diseases during the entire season.

The entire White Rose crop at this time has been sold The seed has been in excellent demand. The 1946 seed has given excellent results and buyers are very anxious to place orders for their 1948 seed supply. (Nov. 26) —Harold S. Schaad.

Canada

Harvesting operations in Prince Edward Island were completed by the first of November. Shipping has continued steadily, but there has been a shortage of railway cars, which has made it difficult to fill orders that were already accepted Every available warehouse and building which could be used for storage was being filled Representations have been made to the railway authorities in an effort to obtain more cars, so that more of this stock could be shipped to its

ultimate destination. It is anticipated that arrangements will be made shortly to overcome these difficulties so that delivery may be made of seed which is now on order.

The total production of certified seed potatoes for this year in Canada is estimated at 11,747,000 bushels. Of this amount, 994,900 bushels are estimated to be of the Foundation grade; 4,342,000 of the Foundation A grade; and 6,410,100 of the Certified grade. These are, of course, preliminary figures, and subject to revision. The more important varieties produced are as follows: Green Mountain, 3,387,-700 bushels, Katahdin, 3,364,100; Irish Cobbler, 2,392,300; Sebago, 1,423,000; Netted Gem, 463,100; and Bliss Triumph, 421,500. The greatest total production was, of course, in Prince Edward Island, where the seed potato crop is estimated at 6,100,300 bushels New Brunswick is second, with an anticipated production of approximately 3,980,000 bushels.

It will be noted that these figures are slightly higher than those for 1946, when the total production for all Provinces was 10,855,400 bushels, that for Prince Edward Island 5,886,600; and for New Brunswick 3,641,000.

The Irish Cobbler variety has dropped from second to third place in production, being replaced by the Katahdin variety, whereas Bliss Triumph has dropped from fifth to sixth place, its place being taken by the Netted Gem variety. (Dec 1).—J. W SCANNELL.

PROVINCE OF ONTARIO

A good demand prevails for seed and table potatoes. Prices have strengthened during recent weeks, with No. 1 table stock, on Toronto market the lowest for Province quoted today (December 3rd) is at $2.50 to $2.65 per 75 pound bag, wholesale to retail. Growers feel they should receive from $ 50 to $1.00 per 75 pound bag premium for Foundation A seed stock. Our 1947 lists of seed growers are now available from the Department.

The potato show at the recent Royal Winter Fair, Toronto, was regarded "as the biggest and best ever held in Canada, far surpassing any previous exhibits". All provinces were well represented, with Grand Championship being awarded to Ross Bros, Pemberton, British Columbia on 30 potatoes of the Netted Gem variety. Joseph Gattie, of Watford, Ontario, was reserve, for his exhibit of Chippewa Variety.

Three growers from Ontario, have obtained record yields for the province, namely, Fred Sohm, Magnetawan, 718 bushels per acre; C H Chapman, Nipissing, 694 bushels; and Frank Rick, Trout Creek, 693 bushels Mr. Rick won a trophy and $250.00 in cash, for high score in quantity, quality and exhibit (Dec. 3).—R. E. GOODIN.

RECORD POTATO YIELDS

The report that R. C. Zuckerman of Stockton, California, produced 1,188 2 bushels, or 7199 hundred-pound sacks per acre has created considerable interest in the potato world This yield was obtained on a measured acre, one of five on Mandeville Island, near Stockton, groomed carefully for the record test The potatoes were of the White Rose variety, planted on the 15th of March, and grew for 147 days They were planted in rows 28 inches apart and spaced 8 inches in the row. Many of the potatoes weighed as much as 3½ pounds each. Fourteen hundred pounds of fertilizer were used. The field was irrigated by subirrigation with ditches every 12 rows. The land had been in pasture for the past four years.

The yields were checked by County Agricultural Commissioner Austin Mahoney and County Inspector George Stipe.

Upon receipt of this news, R. J. Haskell and F. J Stevenson of the U. S. Department of Agriculture did some checking concerning previously reported record yields. They found several reports of yields in excess of 1,000 bushels but the largest was slightly less than that made by Mr. Zuckerman, who broke his own record.

The yields reported below are, of course, for the United States only. There may be higher yields but until evidence is produced, the crown belongs to Mr Zuckerman.

Wallace MacFarland, in the December and January 1933-1934 issues of *Better Crops with Plant Food,* describes the world record potato crop of 1,155.8 bushels per acre grown on Weyl-Zuckerman & Company farm at Stockton, California. Ten sacks of seed potatoes were used per acre, and these were spaced ten inches apart in 30-inch rows. The seed bed was prepared with a pulverizing machine, and 1,000 pounds of 0-15-12 fertilizer were applied per acre. Fertilizer was applied 2 inches below the seed pieces over a width of 10 inches and was thoroughly mixed with the soil to a depth varying from 8 to 10 inches. The crop was planted on the 1st of April and harvested on the 18th of September, 1933.

Western Farm Life 31 (22) 3 (Nov. 15, 1929) reports that L G Schutte of Monte Vista, Colorado, raised 1,145 bushels per acre of Brown Beauty He used 6- to 7-ounce tubers planted whole. They were planted at a depth of 6 inches, 1 foot apart, in rows 34 inches apart. Alfalfa sod land was plowed 14 inches deep in the spring of 1928 and planted to potatoes In the spring of 1929 about 15 loads of manure were applied per acre and land plowed 10 to 12 inches deep

Western Farm Life, Oct. 15, 1931, p 2, states that John Gredig

of Del Norte, Colorado, produced 1,069.06 bushels per acre of Bliss Triumph in 1931. He planted whole seed, treated with an organic mercury compound, planting 1,400 pounds of seed per acre. He planted at a depth of 6 inches. The land was black bottom in which lettuce had been planted in 1928, 1929, and 1930, and in which native hay had been grown 20 years previously. This was plowed to a depth of 10 inches.

Western Farm Life, Vol. 30, 1928, has recorded that in 1928 Mr. L. G. Schutte of Monte Vista, Colorado, raised 1,047 5 bushels of potatoes on one acre. The variety was Brown Beauty. This crop was grown on land that had been in alfalfa for several years. Forty tons of manure were applied, and hand-selected seed was used.

The New England Homestead, Vol. 110, 1937, indicates that in 1889 Mr Philo Reed of Fort Fairfield, Maine, harvested 745 bushels per acre.

The Farquhar Iron Age *Farm News,* April, 1947, points out that Mr. Jacob K. Mast, Caernaron Township, Lancaster County, Pennsylvania, harvested in the fall of 1946, 734 07 bushels per acre of the variety Sequoia All plants were spaced 10 inches in the row and the rows were 32 inches apart. Mr Mast used 1,000 pounds of 4-12-12 fertilizer.

The New England Homestead, Vol 110, 1937, records a statement that Frank R Shaw of Presque Isle, Maine, harvested 701 bushels per acre of Chippewa.

We would like to add one more report to the above list. In New Jersey this year, a yield of 754 bushels per acre was produced in a variety test plot on the farm of Oscar Ketcham, Jr. of Freehold. These potatoes were of the Chippewa variety They were planted on the 28th of April and harvested on the 6th of October. A wheat cover crop on which 1000 pounds of 4-12-8 fertilizer had been broadcast was plowed down in the spring and 1200 additional pounds were applied in bands at the time of planting The yield was officially checked by Mr Richard O. Rice, the Associate Agricultural Agent in Monmouth County.

It is true that this does not approach the 1188.2 bushels produced in California but New Jersey is a much smaller state!

POTATO RESEARCH IN PERU

A study of potatoes in southern Peru is of exceptional interest because the parent stock for varieties now grown throughout the world is believed to have come originally from this region. Together with

Chile, Peru is regarded as the native home of the wild potatoes which were first domesticated by Indians antedating the Inca civilization.

Centuries of cultivation in high mountain valleys with little intercommunication have developed numerous varieties in southern Peru, and in addition there are many of the wild species of the genus Solanum, and varieties of the species *S. tuberosum* Although botanists and plant explorers have made occasional trips to Peru for collection, classification, and introduction of these potato plants, it appears that only a beginning has been made in exploring the economic possibilities of plant material in the region. A chief problem has been the absence of satisfactory botanical collections from which agriculturists could make selections for yield, disease resistance, table quality, appearance, and other economic properties.

Two botanical collections of potatoes are now being established which will be of considerable interest to plant breeders in all countries. One collection is that of Dr. Cesar Vargas C., professor of botany in the Universidad de Cusco, located in the mountain city of Cusco, Peru. The other is that of the Estación de Experimentación Agrícola de la Molina, on the outskirts of Lima.

Since 1939, Dr. Vargas at Cusco has been collecting and propagating domesticated and wild varieties within the high mountain valleys, where potatoes are indigenous at altitudes of 11,000 to 14,000 feet. From approximately 850 clones collected for special study. Dr. Vargas has described more than 300 species and varieties. Herbarium specimens are kept on file for each of the plants studied, and about 200 clones are propagated annually for botanical observation and study. The collection at present is a little difficult to use because of the lack of uniformity among botanists in classifying species and varieties of potatoes, but this may be remedied by further research and comparison Dr. Vargas follows a European system (Juz. et Buk) which classifies numerous separate species of edible *Solanum* tubers, differing from the United States practice of classifying most edible potatoes as varieties within the single species *Solanum tuberosum*

The annual propagation of clones at Cusco so far has been confined only to botanical observation, as Dr. Vargas does not have funds for work in experimental plots By far the most numerous of the clones are those cultivated by small subsistence farmers for home consumption, with small tubers and low yields, but these have possible value with respect to disease resistance or other factors. The collection will provide especially valuable source material for other workers who visit the Peruvian sierra in search of native potatoes, and who have the resources to develop projects in selection and genetics Potatoes in the sierra pro-

duce viable seed, and the collection therefore provides opportunity not only for clonal selections but also for selecting and hybridizing seed to establish genetically stable lines.

At La Molina near Lima, the Peruvian Ministry of Agriculture is propagating plots which include clones from both the sierra and the coast with the objective of testing them under coastal conditions where disease is a particularly serious problem. Over 400 clones are now being observed preparatory to making selections primarily for yield and for disease resistance An immediate objective of this work is the determination of the best clones for a certified seed program under which seed will be brought down annually from the sierra, to be used on the coast where disease prevents maintenance of good seed supply. From the research point of view, however, disease conditions impede the establishment of a permanent botanical collection at La Molina comparable to that which can be maintained in the Cusco region. (Oct. 1947). —AMERICAN EMBASSY, LIMA, PERU.

SAN LUIS VALLEY MARKETING AGREEMENT

WILBUR G. ERICKSON,
Manager San Luis Valley Potato Board of Control

Most of the inquiries that come to us relative to the Colorado Marketing Agreement established by House Bill 738, Session Laws of Colorado 1839, and in particular the agreement set up for the five counties in the San Luis Valley that produce Red McClure potatoes, are (1) How is the agreement instituted in the state? (2) Can it be operated by state or local areas? (3) Is it flexible enough to accomplish the objectives of a changing industry? (4) Does the agreement have "teeth"—can the orders be enforced and assessments collected?

The agreement is presented the General Assembly by Representatives and Senators acting on behalf, and at the request, of producers in the state. Usually there is no opposition to its enactment, as the Act becomes effective, and it is placed in operation only after a majority of the handlers and producers in a defined area signify their willingness to regulate the shipments of their produce by the casting of ballots at a duly scheduled and advertised election. In other words the Act is in the Statutes for any group or district that desires to take advantage of it. At the present time Colorado State Marketing Agreements are being used by the peach producers on the Western Slope; by Mesa County pear growers, and by Red McClure potato growers in the San Luis Valley.

The Marketing Agreement may be operated statewide where commodities are produced in various parts of the state, or they may be organized on an Area basis and boundaries defined by counties where production is localized. Only five counties in Colorado produce Red McClure potatoes commercially, and all of them are situated in the San Luis Valley All the commercial peaches in Colorado are produced in two or three counties in Western Colorado, and Mesa County produces practically all the pears shipped from the state. A marketing agreement on Green Pod Peas or head lettuce would have to be statewide as these commodities are grown in various parts of the state, however, a State Agreement on cauliflower could be localized in about two counties.

The Colorado Act is flexible. It is administered by the Colorado Director of Agriculture who sets up the various boards of control, supervises the election and appoints board members, issues regulatory orders that are recommended by the boards of control, provided always that they are for the benefit of the industry and that no grower will be denied rights and benefits that are available to other growers in like conditions or under similar circumstances.

Under the Act, growers, through their Board of Control can regulate shipments, establish grading standards of quality, condition, size or pack for any agricultural commodity. They can promote the sale of their commodity through advertising and sales promotion plans They can eliminate or regulate "loss selling" by requiring the vendor to post prices, and they can require that all containers be branded with the grade and commodity, and that the net weight of the contents be clearly shown. In short the grower is not only permitted to build up the industry in which he is a producer, but he can protect that industry from unscrupulous growers and distributors who might take the short instead of the long view on what is best for the majority.

The rate of assessments can vary according to the work that is intended to be accomplished, but funds collected for a specific purpose must be used for the accomplishment of that purpose only, and any surplus remaining in the treasury at the close of the season must be prorated back to the grower who paid the assessment

Here in the San Luis Valley an assessment of 1 cent per 100-pound bag of potatoes is collected and allocated on the basis of approximately ¼ cent for administration; ¼ cent for advertising, and ½ cent for improvement work consisting of research work in eliminating disease and insects and improving the quality at the producer level.

The Colorado Director of Agriculture has issued three orders this season at the request of the San Luis Valley Potato Board of Control. (1) An order setting the rate of assessment at 1 cent per 100-pound bag

of potatoes (2) An order prohibiting the shipment of immature Red McClure potatoes between the 2d of September 1947, and the 16th of October, 1947 (3) An order prohibiting the shipment of potatoes in containers that are not clearly marked and branded with the correct net weight when packed

The Colorado Marketing Agreement does have "teeth," and where an agreement is instituted by a majority of the growers, all orders can be enforced through the office of the Attorney General of the state. Where grades or packs of various commodities are shipped in violation of existing orders, the Attorney General can issue a restraining order, and prosecute the offender according to the enforcement provisions contained in the Act. However marketing agreements like all other businesses are based on good will, and a policy of speaking softly is important but it must be backed up with a big stick.

It appears now that marketing agreements, whether Federal or State, will become a very important part in the development of the potato industry, and of course these agreements can overlap with Federal Agreements embracing large production areas consisting of several states, and State local agreements performing a more flexible function of assisting the grower in producing better quality, and making available to him the services of various technicians that can visit his farm and help to solve his problems. Many problems of production arise that can not be solved on the farm by individuals, but collectively they may have the problem solved for them

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